A Mixed Methods Examination of Attitudes and Perceived Mood Change and Well-Being Across the Menstrual Cycle.

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Most of all I want to thank Sate and The Boss because without friends like these I'd be hopelessly lost. "I know, I know" ☺☺

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Abstract

This thesis examined the influence of menstrual cycle phase and hormonal contraceptive use on mood and well-being. Focus groups examined attitudes towards the menstrual cycle, and thematic analysis identified negativity about the menstrual cycle and a perception that males are disgusted by menstruating females. These themes were probed in males and while some had negative attitudes towards menstruation many regarded it as a natural process and were surprised to be asked about disgust towards menstruating females. Prior to examining mood and well-being changes, a non-invasive and inexpensive protocol was developed for identifying where testing should be carried out if differing levels of hormones were to be captured. Testing format used a three-phase approach which added a mid-luteal phase to the more typical menstrual and ovulatory phases. This was designed in order to capture the influence of a surge in progesterone levels at this point. As the influence of progesterone on mood and well-being is not well-known, it was predicted that there would be an effect of menstrual cycle phase on both. Alongside this, an investigation of the influence of hormonal contraceptive (HC) use on mood and well-being was also conducted. Menstrual cycle phase effects were found in relation to mindfulness and curiosity. These results suggest females are more conscious of their body as menstruation approaches and more motivated to seek out novelty when menstruation begins. No hormonal contraceptive effects were found, however, participants in this group were treated as a homogenous group of hormonal contraceptive users. In actuality, a number of different types and generations of hormonal contraceptives were being taken by these participants and had sample size been larger comparisons could have been made between these groups. Overall, this thesis takes the first steps in investigating the influence of higher levels of progesterone in combination with relatively high levels of estrogen on mood and well-being. Although few significant effects were

found, a series of interesting trends were identified, and it makes a valuable contribution to the literature, which warrants further research.

Chapter 1: General Introduction, Literature Review and Thesis Aims

1.0 Overview

Most females experience menstruation over the course of their reproductive years and will menstruate, on average, 400 – 450 times (Aydos, Elhan & TüKün, 2005; Mihm, Gangooly & Muttukrishna, 2011). Many females report changes in mood and behaviour related to their menstrual cycle phase and a number of research findings support this. Changes relating to menstrual cycle phase have been reported in: cognitive performance (e.g. Griksiene & Ruksenas, 2011; Hussain, Shams, Waqqas & Brake, 2014; Keogh, Cavill, Moore & Eccelston, 2014; Mordecai, Rubin & Maki, 2008); mood (e.g. Celec, Meseznikov, Ostatnıkov & Hodos, 2011; Keisner & Pastore, 2010; Keisner & Poulin, 2012; Szollos, 2006); perception of pain (Ahmed, Khan, Ali, Haqhawaz, Hussain & Azam, 2012); emotion (Roder, Brewer & Fink, 2009); weight (Konin, Burtman & Hudson, 2008); smell (Derntl, Schopf, Kollndorfer & Lanzenberger, 2013; Doty & Cameron, 2009); risky behaviour (Combes, Stone, Combs & Kempton, 2006; Sukolova & Sarmany-Schuller, 2011) and attractiveness (Harris, 2011; Jones, DeBruine, Perrett, Little, Feinberg, Law & Smith, 2008). However, this list is not exhaustive and other differences have also been reported. These behavioural differences have been attributed to fluctuations in hormones, with estrogen most commonly cited as the causal effect.

1.1 Thesis Aims

As described above, a number of menstrual cycle phase effects have been reported in relation to behavioural processes. However, one criticism is that many of these studies used a two phase split, comparing times of high and low fertility, suggesting fluctuations in estrogen levels as the causal factor

(Jones et al., 2008; Oinonen & Mazmanian, 2007; Roney & Simmons, 2008). Recent research (e.g. Bayer & Hausmann, 2012) has suggested that a more comprehensive approach should be adopted, dividing the menstrual cycle into three phases, where the influence of progesterone can also be addressed (see Section 1.2 for more details). With this in mind, this thesis will take a novel approach by examining attitudes qualitatively. Mood and well-being were examined (quantitatively) across three phases of the menstrual cycle. Additionally, most research conducted across three phases records behaviour in the pre-menstrual, menstrual and ovulatory phases (Garrett & Elder, 1984; Pearson & Schipper, 2013). In this thesis quantitative testing will be conducted during the menstrual phase, ovulatory phase and the mid-luteal phase. Testing at the mid-luteal phase will allow behaviour to be monitored when progesterone levels are high and estrogen levels are in their second but reduced peak. This is important, as the effects of estrogen in combination with high levels of progesterone are rarely reported and where progesterone effects are examined, research tends to focus predominantly on females' negative experiences in the premenstrual phase of their cycle. Established differences in behaviour observed in the ovulatory phase of the cycle may be diminished or enhanced in the mid luteal phase, when peak progesterone levels combine with relatively high levels of estrogen. This then would suggest progesterone does influence behaviour. To address this, there will be development of a protocol for a three phase testing approach that will be used in the current thesis (see Chapter 3 for details). The quantitative data in the thesis will be an examination of potential mood and well-being differences between naturally cycling females using the three phase approach, and hormonal contraceptive users. In most previous research, women using hormonal contraceptives are included as a control group; however, there is some evidence to suggest that hormonal contraceptives can influence behaviour and that females using hormonal contraceptives behave differently to naturally cycling females (Wharton et al, 2008).

This chapter will be split into three sections with the first providing an overview of the average 28-day menstrual cycle. Each menstrual cycle phase is described with reference to the hormones involved and the effect these have on the female reproductive system. The second section details the systematic literature review that was carried out for the thesis and research deemed relevant is presented in tabular form. This is then followed by a brief critical evaluation of what the tabulated research shows, what the limitations in present understanding are, and where the current work will take things and this will be expanded in the analytical chapters. The final section of the introduction reviews hormonal contraception, detailing the type of contraceptives available and describing how these act on the reproductive system.

Section 1. Introduction to the Menstrual Cycle

1.2 The Average 28 Day Menstrual Cycle (AMC)

In order to understand the psychological changes which may be influenced by fluctuating hormone levels across the menstrual cycle, it is important to first understand the cycle itself. The average menstrual cycle (AMC) (Figure 1.1) is 28 days in length and, as a minimum, can be split into two parts, the follicular phase and the luteal phase (Griksiene et al., 2011; Keogh et al., 2014). The follicular phase is the initial part of the cycle, lasting approximately 14 - 16 days and is followed by the luteal phase which lasts approximately 13 – 15 days (Ecochard & Gougeon, 2000; Waller et al., 1998). Day one of the AMC is the first day of menses (the first day of menstrual bleeding), and this lasts for approximately five to seven days (Hausmann, 2005; Keogh et al., 2014). On day 14 of the AMC, ovulation is assumed to take place (Mihm et al., 2011), and this is followed by the luteal phase which continues until menstruation.

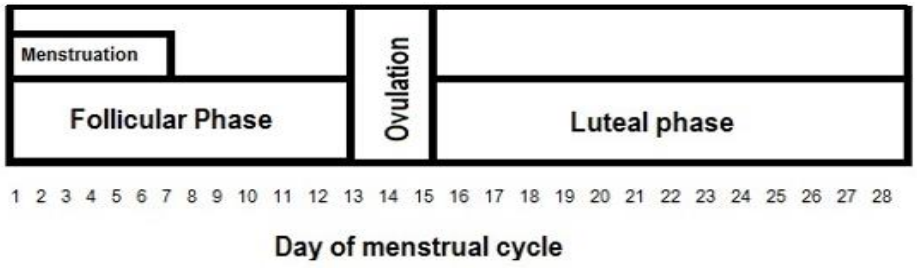


Figure 1.1

Follicular and Luteal phases of the average menstrual cycle (AMC).

Hormones are chemical in nature, with some that are amino acid based made from cholesterol and others that are prostaglandins made from lipids found in cell plasma or membranes (Neave, 2007). Hormones are responsible for the metabolic activity of cells in the human body and are released by the endocrine glands, travelling through the blood stream to a specific target cell for which they regulate function (Barnes, 2013). Amino acid hormones include catecholamines (adrenaline and noradrenaline) and thyroid hormones (thyroxine and triiodothyronine), while peptides include oxytocin and luteinizing hormone (Neave, 2007). Prostaglandins stimulate and relax muscles; influence cardiac functions and can cause contractions of the uterus (Barnes, 2013).

In the AMC the key hormones responsible for fertility are estrogen and progesterone, however, these are not the only hormones that alter across the course of the menstrual cycle (Figure 1.2). During the follicular phase the follicle develops, then ovulation occurs and in the final phase (luteal phase), the body (womb) prepares for pregnancy. If fertilisation of the egg does not occur, hormone levels drop sharply and menstruation begins (Heffner & Schust, 2010). The AMC is not experienced by all females and menstrual cycle length can range from 24 to 36 days with a wider range in younger (i.e. 12 – 15 years) and older (45 – 55 years) females (Adams-Hillard, 2008; Wallace & Kelsey., 2010). Phase length also differs across females and can change between individual menstrual cycles (Mihm et al., 2011). This can be relatively problematic for researchers conducting research in this field if methods used to pinpoint ovulation are not based on different hormone level measurement (see Chapter 3

section 3.2), particularly when testing across different phases, and for more than one cycle (see Chapter 3 section 3.2). However, although the possibility of irregular cycles may be an issue, especially where sample sizes are small, an examination of the literature suggests that it may not be a fatal problem. A study by Solomon et al. (2002) examined the usual menstrual cycle pattern in a very large cohort sample of female nurses in the USA (120,000+). The research asked the nurses "to describe the regularity of your usual menstrual periods between ages 20 and 35 when you were neither pregnant nor using oral contraceptives". Self-report data found that 84.8% of the sample agreed that they were very regular/usually regular. A similar examination of this cohort when aged 29–35 years, found that 87% reported cycles that were regular. This suggests that it is reasonable to expect that the majority of participants in the current study who fit within this age bracket, will be relatively regular in their cycles.

The menstrual cycle is driven by the activity of the hypothalamic Gonadotropin Releasing Hormone (GnRH) pulse generator and surge centre (see Section 1.3 for details). Gonadotropins are released from the pituitary gland and this causes changes in the secretion of steroids by the ovaries. Structural changes occur at the same time in the ovaries and in the lining of the womb.

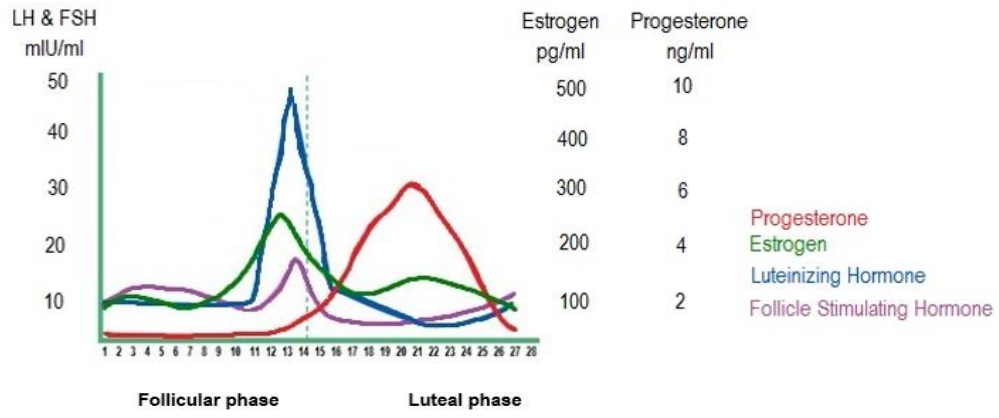


Figure 1.2

Hormone levels in the follicular and luteal phases of the AMC.

Follicular Phase (Days 1 - 14): The follicular phase occurs over the first 14 days of the AMC and includes menstruation, with the first day of menses regarded as day one of the menstrual cycle. Menstruation is the sloughing of the lining of the uterus which is discharged as blood and endometrium through the vagina. Bleeding is at its heaviest on day two and typical blood loss is around 30 mls (Mihm et al., 2011). Follicle Stimulating Hormone (FSH) and Luteinizing Hormones (LH) are released on day six (see Figure 1.2). FSH targets an egg which then begins to grow and form a sac. As the egg grows, estrogen develops in the ovaries and this causes a thickening of the lining of the uterus.

Ovulation (Day 14): Ovulation needs LH but why it is required is not clear. However, it is believed that prostoglandins could be one of the mediators of LH. LH stimulates the biosynthesis of prostoglandins and animal studies have shown that if prostaglandins are inhibited, ovulation will not occur (Heffner & Schust, 2010). In addition to this, plasminogen is converted into plasmin in response to FSH and may be responsible for the FSH surge that is observed at ovulation. In this phase the egg moves from the ovary into the fallopian tube, moving towards the uterus where it remains for 12 – 24 hours. The egg sac remains in the ovaries and starts to produce progesterone. This, combined with estrogen, continues to thicken the lining of the uterus.

Luteal Phase (Day 15 – 28): The key feature of the luteal phase is the development, and maintenance, of the corpus luteum. At this stage in the menstrual cycle, the endometrium becomes thick and spongy and glands now begin to secrete nutrients that would sustain an embryo if conception were to take place. This phase of the cycle is also called the secretory phase as the uterus secretes progesterone and estrogen at this stage (Mihm et al., 2011). The luteal cells produce high amounts of estrogen, equivalent to the levels at the approach to ovulation and at the same time levels of progesterone and 17-hydroxyprogesterone are secreted. This combination prevents a second LH

surge with the high levels of estrogen and progesterone resulting in low levels of FSH and LH secretion (Heffner & Schust, 2010). At this stage the uterine muscles do not contract as much as they do during the follicular phase. Unlike the follicular phase, which varies in length, the luteal phase is generally around 14 days in duration (Ecochard & Gougeon, 2000; Fehring, Schneider & Raviele, 2006). If fertilisation does not occur the egg moves down through the uterus. The egg sac (corpus luteum) disintegrates and stops producing progesterone which causes the lining of the uterus to break down. At this stage all hormone levels drop sharply and menstruation begins (Kasamatsu et al., 2002)

1.3 The Female Reproductive System

The female reproductive system comprises of all the structures required for the formation and development of a child (Figure 1.3) and includes the uterus, the ovaries, the fallopian tubes, the vagina and breasts. The reproductive organs (the uterus, the ovaries and the fallopian tubes) are involved in the menstrual cycle, and will be outlined in more detail below.

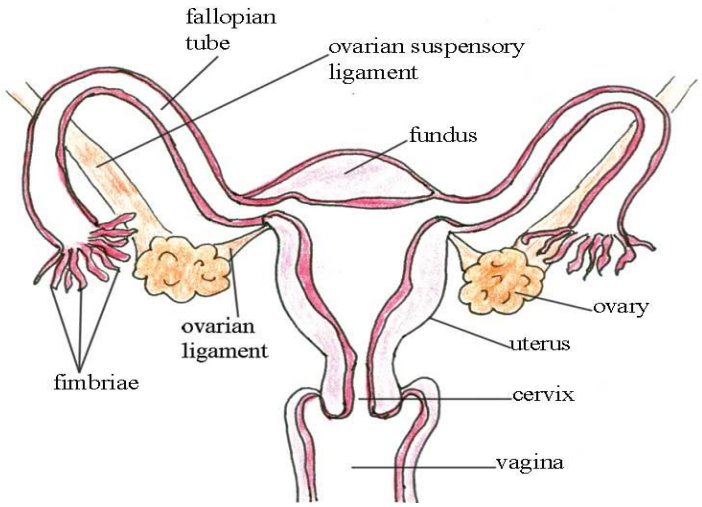


Figure 1.3

Female reproductive system (http://www.open.edu/openlearnworks).

The Ovaries: The ovaries are almond in shape and are located in the pelvic cavity (Figure 1.3). In addition to producing eggs, they also produce two groups of steroid hormones (estrogens and progestins). Ovaries do not fully function until puberty when they are stimulated into activity by gonadotropic hormones. The hypothalamus discharges Gonadotropin-Releasing Hormone (GnRH) which stimulates the anterior pituitary to secrete Follicle Stimulating Hormone (FSH) and Luteinizing Hormone (LH). This causes ovarian hormones to rise and fall initiating the ovarian cycle (Hawkins & Matzuk, 2008).

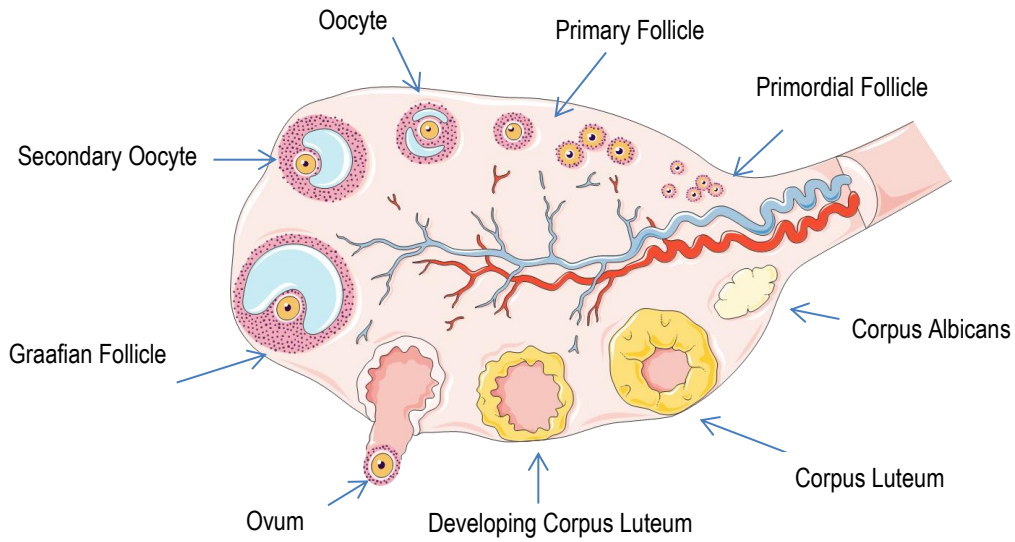


Figure 1.4.

Anatomy of an ovary (produced using Servier Medical Art (www.servier.com)).

Ovaries contain minute sac-like structures called ovarian follicles (Figure 1.4) each of which contains an oocyte or immature egg surrounded by follicle cells. The follicle develops from a primary, to secondary, to a vesicular, or graafian, follicle. The epithelium of the primary follicle surrounds a primary oocyte while in the secondary follicle the oocyte is surrounded by fluid. The fluid within this vesicular follicle increases until the wall of the follicle balloons out on to the surface of the ovary (Heffner & Schust, 2010). The secondary oocyte then enters a uterine tube awaiting fertilisation. A follicle that loses its egg becomes a corpus luteum and if implantation fails to take place the corpus luteum begins

to degenerate after 10 days. This causes a white scar called corpus albican to be formed on the ovary. A number of follicles begin growing at the start of each month but only a single oocyte matures and ruptures to release the secondary oocyte. Females are born with up to two million follicles but by puberty this is reduced to three to four hundred. Around four hundred mature fully, with females producing one per month between menarche and menopause (Mihm et al., 2011).

Follicular Growth: Primordial follicles are made up of an oocyte surrounded by granulosa cells called the membrane granulosa, and these are located in the periphery of the ovarian cortex. Those that double in size become primary follicles, and this growth is caused by an increase in size of both the oocyte and the granulosa (Hawkins & Matzuk, 2008). The granulosa is still a single layer of cells but these now become cube like in shape rather than flat and there is now a connective tissue called theca covering the granulosa. The primary follicle continues its growth and the granulosa cells undergo mitosis increasing the cell layers from a single layer to between two and six layers. This alteration from primary to secondary follicle is relatively slow taking around 120 days (Figure 1.4). Some secondary follicles grow to become tertiary follicles, a change which takes between 60 to 90 days. During this process the granulosa cells secrete antral or follicular fluid that builds up between the cells causing additional fluid to leave pores in the thecal blood vessels. As much as 80% of the proteins present in blood plasma in the thecal vessels can be secreted and diffuse into the antral cavity and this fluid consists of steroid and protein hormones as well as anti-coagulants and electrolytes (Heffner & Schust, 2010).

Tertiary follicles have a membrane granulosa of several layers while the theca has two; the theca interna containing glandular cells and blood cells; and the theca externa comprising thick connective tissue and larger blood vessels. The oocyte along with the cumulus oophorus which is a mass of granulosa cells, begins to bulge into the antral fluid. The oocyte is surrounded by a sphere of cumulus

cells that remain until ovulation takes place (Figure 1.4). Tertiary follicles are not all the same and differ in size depending on their state of development. Resting tertiary follicles range from 1 – 9 mm in size while ripe tertiary follicles are between 10 and 14mm and graafian tertiary follicles are 15 – 25mm in size and the growth period takes around about 3 weeks. At this stage early antral follicles have begun to build up fluid but have not yet merged into a single antral cavity (Heffner & Schust, 2010). Antral follicles have a single antrum, the largest of which is a graafian follicle. Graafian follicles are very vascular theca and one of these is "selected" to become fully mature during each menstrual cycle (Figure 1.4). This pre ovulatory follicle continues to grow until it forms a blister like bulge on the surface of the ovary prior to ovulation. All remaining tertiary follicles now become atretic (begin to degenerate) and this is followed by fragmentation of the cell (Ginther et al., 2004). Leukocytes remove any cellular remains; however, the atretic cells leave scars on the surface of the ovary (Heffner & Schust, 2010).

The Uterus: Uterine or fallopian tubes extend from the uterus to the ovaries (Figure 1.3) and are lined by columnar epithelial cells, some of which are ciliated. During ovulation, fimbriae sweep over the ovary creating a suction effect causing the secondary oocyte to enter the uterine tube. If fertilisation occurs oogenesis is completed and a zygote is present. The developing embryo is moved slowly towards the uterus driven by the action of the cilia and contractions of the wall of the uterine tubes. The journey takes several days and when it arrives the uterine wall is prepared for receiving it (Hawkins & Matzuk, 2008). The uterus has three sections: the fundus: which is superior to the entrance of the uterine tubes; the body: which is the major region and the cervix: which is the narrow end of the uterus that projects into the vagina (Figure 1.3).

The uterus (Figure 1.3) is shaped like an inverted pear and is situated above, and tipped over, the bladder. The thick walls of this muscular organ have three layers (outer, middle and inner). The outer layer forms part of the covering for the pelvic cavity and the middle, muscular layer which is the part of the uterus that contracts during childbirth when oxytocin is present. The inner layer is the endometrium which also has two layers. The first layer is the lining of the uterus, which is shed during menstruation, and the second layer is permanent and produces a new lining following menstruation.

Menarche is an indication that a female has reached sexual maturity and generally occurs in the early teens; menstruation continues until menopause (cessation of menses) at around 50 years of age (Mihm et al., 2011). The menstrual cycle is orchestrated by an interaction between the hypothalamus, the anterior pituitary, the ovaries and endometrium. Gonadotropin Releasing Hormone (GnRH) is secreted by the hypothalamus and this stimulates Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH). Gonadotropins stimulate the ovaries to produce steroid hormones including estrogen and progesterone (Figure 1.5). This stimulation causes endometrial proliferation which prepares the uterus for ovulation (Hawkins & Matzuk, 2008). If conception does not take place, the lining of the uterus will shed and menses commences.

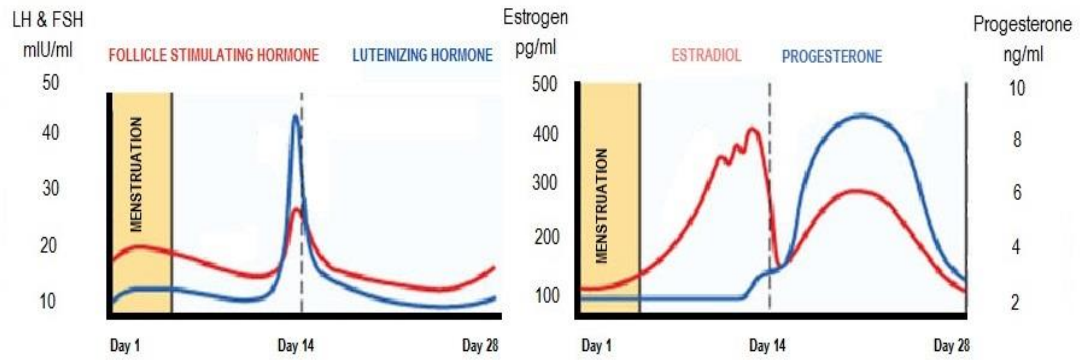


Figure 1.5

Levels of FSH, LH, Estrogen and Progesterone over the course of the AMC.

***Gonadotropic Hormones*:** Gonadotropic hormones include the glycoprotein hormones, FSH and LH. FSH stimulates the growth and development of the primary follicles leading to hormone production in the ovaries, while LH causes ovulation, the forming of corpus luteum, hormone production in the ovaries and stimulates hormone production (Figure 1.5). Regulation of LH and FSH is driven by GnRH, a decapeptide (chain of 10 amino acids), that is synthesised in the arcuate nucleus of the basal hypothalamus and in the preoptic area of the anterior hypothalamus (Heffner & Schust, 2010).

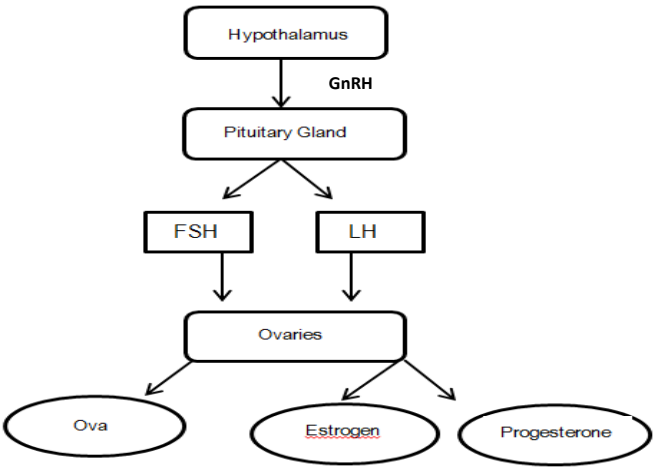


Figure 1.6

Hormonal regulation of the menstrual cycle from the hypothalamus to the ovaries.

GnRH is released from the hypothalamus in pulses by a pulse generator thought to be located in the medial basal hypothalamus (Figure 1.6). The frequency of the pulse mechanism changes over the phases of the menstrual cycle with the most rapid pulsing taking place in the follicular phase. The pulsing is slower during the early luteal phase and is at its slowest during in the late luteal phase of the cycle. Faster pulsing of GnRH is related to LH secretion while slower pulsing is related to FSH secretion (Heffner & Schust, 2010). The slowing of the pulsing in the late luteal phase is vital in triggering the next menstrual cycle. Estrogen, progesterone and androgen all have a negative feedback effect on the secretion of LH and FSH, however, at certain times in the menstrual cycle estrogen exerts a positive feedback effect on gonadatropic secretion. Without this positive feedback

effect the sustained increase in circulating estradiol would not occur and this is required for the LH surge and subsequent ovulation (Rees, Hope & Ravnikar, 2005).

1.4 Hormones and the Menstrual Cycle

Ovarian hormones ready the female body for reproduction, preparing the lining of the womb so it can sustain a fertilised egg (Swanepoel, Lindeque, Swart, Abdool & Pretorius, 2014). In the follicular phase FSH and LH stimulate the production of estrogen which leads to the production of endometrial cells. In the luteal phase of the menstrual cycle the production of progesterone acts on endometrial cells preparing the uterus for pregnancy. If pregnancy fails to occur hormone levels drop sharply causing the lining of the uterus to shed (Dasharathy et al., 2012).

Anovulatory cycles: Anovulatory cycles are those in which ovulation does not occur and can be an indication of infertility (McCartney & Marshall, 2016). Physiological causes include disorders relating to the hypothalamus, the pituitary, the ovaries, or can be related to other endocrine related disorders such as hypothyroidism (Hamilton-Fairley & Taylor, 2003). Functional hypothalamic disorders also cause amenorrhea (lack of menstruation) and these are associated with a decrease in GnRH pulse generation. Diseases linked to the hypothalamus such as lymphoma can cause a disruption of input from the Central Nervous System (CNS) to the pulse generator which in turn disrupts the production of GnRH. (Ascoli & Cavagnini, 2006; Paun et al., 2014). The most common ovarian cause of anovulation is polycystic ovary syndrome (Hamilton-Fairley & Taylor, 2003). Polycystic Ovary Syndrome (PCOS) presents with oligomenorrhea or amenorrhea as well as the physical signs of hyperandrogenism such as excessive hair growth or acne and enlarged polycystic ovaries. An overproduction of GnRH secretions leads to elevated levels of LH and in the ratio of LH to FSH. This causes the theca cells in the ovary to respond by increasing the conversion of cholesterol to androgens which in turn reduces the conversion of androgens to estrogens. The resulting hyperandrogenism

causes follicular arrests and anovulation (McCartney & Marshall, 2016; Norman, Dewailly, Legro & Hickey, 2007).

In an anovulatory cycle FSH, LH and progesterone fail to reach the levels required to trigger ovulation. In the early follicular phase FSH levels fall below 3.9 IU/L (International units – a measure agreed by clinicians) and towards ovulation remain below 4.5 IU/L. FSH levels below 1.8 IU/L in the luteal phase confirm that ovulation has not occurred. LH levels are also reduced in the follicular phase (< 2.1 IU/L), the mid cycle phase (< 20 IU/L) and the luteal phase (<1.2 IU/L). Progesterone levels in the mid-luteal phase falling below 3 nmol/L (nanomole – a measure equivalent to one-billionth of a mole) confirm that ovulation has not occurred (Hamilton-Fairley & Taylor, 2003). Evidence suggests that anovulation can affect up to 7% of women with normal length menstrual cycles but can occur more frequently in women who experience shorter or longer menstrual cycles (Mihm et al., 2011 Based on this, it is expected that women who experience normal menstrual cycles will ovulate in the majority of menstrual cycles.

1.4.1 Key Hormones involved in the Menstrual Cycle

Table 1.1

Key hormones involved in the menstrual cycle and their functions.

Hormone	Function
Gonadotropin Releasing Hormone (GnRH)	Signals pituitary gland to release FSH and LH
Follicle Stimulating Hormone (FSH)	Stimulates the development of the ovarian follicle
Luteinizing Hormone (LH)	Stimulates the ovaries to produce estrogen and progesterone
Estrogen	Promotes the maturation and release of an ovum
Progesterone	Prepares endometrium for the ovum and suppresses release of estrogen following ovulation

Table 1.1 represents the key hormones involved in the menstrual cycle, and outlines their functions. The menstrual cycle is driven by a series of hormonal fluctuations. Estrogen and progesterone are

produced in larger amounts for a longer proportion of the cycle than the other key hormones, which tend to have a brief pulse centred on ovulation (Figures 1.2 & 1.5) (Hawkins & Matzuk, 2008). Estrogen has two separate pulses: a large peak in the follicular phase and a smaller increase in the luteal phase, while progesterone has a single large plateau in the luteal phase (Swanepoel et al., 2014). In both cases these hormones are expressed in their highest levels for two to three days at a time, and so have the potential for sustained effects during this time period.

Estrogens: There are a number of different estrogens produced by the body, including estradiol, estrone and estroil (Hawkins & Matzuk, 2008). Estrone and estradiol are produced by graafian follicles of the ovary (Figure 1.4) and as well as their role in the menstrual cycle, they have a physiological role in the female body. In terms of reproductive health, estrogen promotes the growth of vaginal epithelium which offers protection against any trauma or infection and facilitates the passage of sperm. In addition to this, it causes a thickening of the fallopian tubes and stimulates the liver to produce blood proteins important to clotting (Rees et al., 2005). Estrogen works with progesterone in the luteal phase to prepare the uterus for receiving a fertilised egg. These hormones combine to act on the uterus and bring about the cyclic changes that are the menstrual cycle. If pregnancy occurs, estrogen readies the breasts to produce milk, although during pregnancy the source is from the placenta rather than the uterus. Females tend to bruise more easily and bleed more during menses and estrogen acts on capillary walls to strengthen them (Hawkins & Matzuk, 2008). In addition to this, estrogen increases bone formation and encourages the growth of duct tissue which increases the size of the breasts. Estrogen also reduces blood cholesterol levels, influences total body configuration and impacts on body temperature, lowering temperature in the first half of the menstrual cycle (Hawkins & Matzuk, 2008).

Of particular interest for the current thesis, estrogen has also been shown elevate mood (Brown, 2014) or reduce negative affect (Almeida, 1999; Demetrio et al., 2011; Hogervorst, Boshuisen, Riedel, Willeken & Jolles, 1999). In this thesis participants will be tested in the ovulatory phase (see Chapter 3 section 3.4) to create a window of testing when estrogen levels are high (see Section 1.7 for details). Estrogen levels are low in the early follicular phase of the menstrual cycle and range from 19 – 83 pg/mL (picograms per millilitre, a measure equivalent to one trillionth of a gram), increasing as ovulation approaches and peaking at around 64 – 528 pg/mL when ovulation occurs. Following ovulation estrogen levels drop to around 60 – 211 pg/mL then continue to drop to around 55 – 150 pg/mL as menstruation approaches (Beynnon et al., 2005).

Progestins (Progesterone): Progestins are responsible for the changes in the endometrium after ovulation has taken place and they also have a physiological role to play (Jones & Lopez, 2011). Progesterone is involved in readying the uterus for pregnancy; if a pregnancy occurs, progesterone relaxes the uterine muscles preventing miscarriage and preparing breast tissue for lactation. In terms of contraceptive properties, progesterone thickens cervical mucus, preventing the passage of sperm and increasing body basal temperature. Progesterone levels are at their lowest levels during menstruation and range from .2 – 1.4 ng/mL (nanograms per millilitre), a measure equivalent to one billionth of a gram). Levels rise sharply in the mid-luteal phase to around 4.4 – 28 ng/mL and remain high in the late luteal phase at around 3.3 – 25.6 ng/mL (Beynnon et al., 2005).

The relationship between progesterone and behaviour is relatively under researched. Research examining mood and the menstrual cycle is often related to the increased negative mood and physiological symptoms experienced by some females when progesterone drops in the premenstrual phase. While there is some indication that lower levels of progesterone might be related to

premenstrual syndrome (PMS) (Magill et al., 1995), research exploring progesterone-based treatments report inconsistent findings. Some researchers argue that increased progesterone levels in females using hormonal replacement increases negative mood symptoms (Andreen et al., 2009; Backstrom et al., 2003), while others report that lower levels of progesterone are associated with higher negative mood (Oininen & Mazmanian, 2002). Exploring the relationship between progesterone and behaviour is one key aim of this thesis. Measures of mood and well-being will be recorded in the mid-luteal phase in an attempt to capture high levels of progesterone (see Section 1.7 and Chapter 3 Section 3.4).

Androgens: While estrogen and progesterone are key hormones of interest in this thesis, other hormones fluctuate over the course of the menstrual cycle. Androgens are responsible for characteristics that are typically male, but also have a physiological role in females. Androgens, and more specifically testosterone, increase secretions in the sebaceous gland leading to acne, and overproduction in females can cause excessive hair growth, deepening of the voice and changing body fat distribution (Hawkins & Maztuk, 2008). Androgens also play a role in the menstrual cycle: levels fluctuate across the different phases and are thought to drive an increase in sexual desire particularly in the ovulatory phase of the menstrual cycle (Bullivant et al., 2004; Pillsworth, Haselton & Buss, 2004; Wallen, 2013). Testosterone levels in the follicular phase range from 1.04 to 0.76 nmol/L and rise as ovulation approaches to peak at 1.52 to 1.03 nmol/L prior to the LH surge. Following ovulation, levels decrease to 1.1 nmol/L in the late luteal phase (Sinha-Hakim et al., 1998).

1.5. Overview of the Influence of Menstrual Hormones on Behaviour

The hormonal fluctuations that occur over the course of the menstrual cycle can influence behaviour. Testing over the menstrual cycle may be carried out during different phases to compare mood or

memory effects (e.g. Ziomkiewicz et al., 2012). Additionally, the performance of females with natural menstrual cycles can be compared with the performance of females who use hormonal contraceptives to examine if these groups behave differently. Testing can be carried out multiple times depending on which hormonal effects the researcher wishes to measure or observe. There is, however, a level of inconsistency in how often testing takes place in published sources, and the phases in which testing takes place (this will be discussed in detail in Chapter 3).

Examining menstrual cycle phase effects can be carried out using a within or a between subjects design. A within subjects design compares the performance of the same participants in two or more menstrual cycle phases (Celec, et al., 2011; Kozaki & Yasukouchi, 2009; Schoning et al., 2007). In a between subjects design, participants are assigned to independent groups based on phases, and the performance of these groups (phases) compared (Calhoon-La Grange, Jones, Reyes & Ott, 1993). There is some debate as to the appropriateness of a between subjects design due to individual differences such as differences in personality, conscientiousness or culture, that might influence performance (Cobey et al., 2012), and thus a within subjects design is considered more powerful (Gonzales & Ferrer, 2015). As previously mentioned there is a lack of consistency regarding the specific phases in which testing should take place, and which days of the menstrual cycle constitute each phase, and this will be evaluated in Chapter 3.

Section 2 Systematic Review of Current Literature

1.6. Review of existing literature pertinent to thesis

In order to source relevant research articles to support the quantitative research (Chapters 3 and 4) for this thesis, a systematic search of the literature was carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). For Chapter 3 the aim was to search for research relating to the measurement or charting of the menstrual cycle.

For Chapter 4 the aim was to source research articles relating to menstrual cycle phase effects on positive traits, mood and well-being research. Searches were carried out using the Science Direct, PsycArticles and Psychology and Behavioural Sciences databases.

As can be seen across all of the search results, the literature reviews carried out for each of the chapters initially returned many more articles than were appropriate to introduce the areas for research. It was decided to make use of very specific search terms in order to have a more focussed and systematic review. This was done in order to formulate the research questions and is supplemented by more general and wide-ranging searches, which informed the content of each specific chapter.

1.6.1. Outline of systematic literature review for Chapter 3 (Charting the Menstrual Cycle)

The aim of Chapter 3 was to establish an effective, non-invasive and inexpensive method of predicting menstrual cycle phase, so that participants could be tested at appropriate points. Current methods needed evaluating and the actual days of testing to capture different hormonal environments needed to be established to develop a robust testing protocol for this thesis. With this in mind, a systematic search of the literature was carried out to identify articles that provided detailed descriptions of the hormonal profile of the menstrual cycle and the phases of the cycle. Research describing hormonal profiles for short and long, as well as average menstrual cycles were sought in order to ensure greater accuracy in assigning test dates for participants.

Table 1.2

Inclusion and exclusion criteria for literature review of research related to measuring or charting the menstrual cycle.

Parameter	Inclusion Criteria	Exclusion Criteria
Focus	Measuring the menstrual cycle	No reference to measurement or charting of menstrual cycle
Time period	1980 - 2016	Published prior to 1980

As shown in Table 1.2, time limits were applied to the search and only research published after 1980 was included. Although the basic calendar methods such as the count back method have changed little over time, technological advances mean that some current methods are more sensitive and accurate than those used prior to this date (Spencer, 2013). The search was also limited to full text online items, items that were peer reviewed and journal articles. Alternative spellings of words were used (e.g. Oestrogen, Estrogen) to ensure maximum return of relevant items.

Table 1.3

Specific search terms employed in literature review for Chapter 3.

	Search term	Results
1	Measuring/charting the menstrual cycle/menstruation	842
2	Menstrual cycle phases/Phases of the menstrual cycle	9243
3	Menstrual cycle variability/variability of menstrual cycle	1978
4	Menstrual cycle phase length	1575
5	Menstrual cycle hormones/hormones and menstrual cycle	8705
6	Hormone profile of menstrual cycle/menstruation	494
7	O/Estrogen and menstrual cycle/menstruation	4464
8	Progesterone and menstrual cycle/menstruation	1010
9	Count back/forward method	824
10	Hormonal Assay of menstrual cycle	157
11	Cervical mucus measurement	96
12	Ovulation prediction	856

Table 1.3 represents the search terms employed in the search. The similarity of some of the search terms (measuring the menstrual cycle; charting the menstrual cycle; measuring menstruation; charting menstruation) led to a very high number of duplicate papers being returned. Additionally, a very high

number of articles with the words 'menstrual cycle' and 'menstruation' in their title were returned but were not related to the topic being examined (methods of measuring the menstrual cycle) (e.g. Rudski, Bernstein, & Mitchell, (2011) examining the effects of menstrual cycle phase on ratings of implicitly erotic art). Once these were removed, the remaining articles were examined initially by title to identify duplicate articles and then to assess the relevance to the chapter of returned items. After this process was completed, abstracts of the remaining articles were read to further assess the relevance of each article to the chapter. Remaining articles were then read before a decision about inclusion in the chapter was taken.

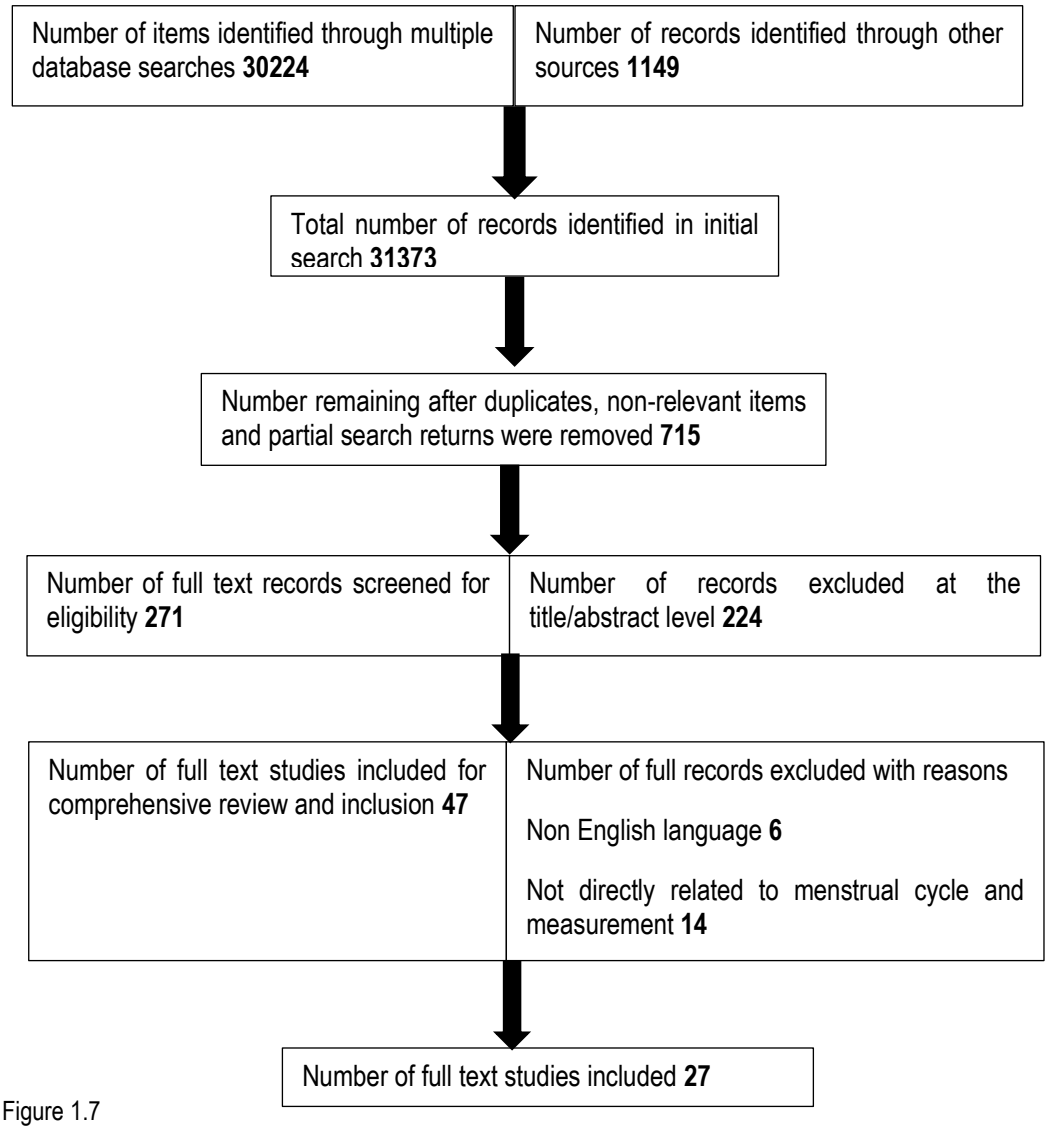


Figure 1.7

Flow diagram of literature search for Chapter 3 based on PRISMA guidelines (Moher et al., 2009).

As figure 1.7 shows, a total of 271 articles were judged to be relevant to the chapter and of those only 27 directly described techniques for measuring the menstrual cycle or menstrual cycle phase length. It should be noted, however, that additional papers are included in the chapter that do not directly refer to the measurement of the menstrual cycle but make use of the methods described. Table 1.4 represents the 27 studies which form the basis for the preliminary discussion of content appropriate for this chapter.

Table 1.4

Summary of the studies included in the Chapter 3 literature review

Authors	Topic under examination	Results
Alliende, Cabezon, Figuero & Kottman (2005)	Examination of Cervico vaginal fluid changes as a means of detect ovulation accurately	Successful in predicting ovulation in 76% - 97% (±2 days) of cycles
Bigelow et al. (2004)	Mucus observations in the fertile window: a better predictor of conception than timing of intercourse	Pregnancy significantly more likely to occur if cervical mucus is observed ($p < .001$)
Brunelli et al. (2007)	Globular structure of human ovulatory cervical mucus	Describes the content and structure of cervical mucus
Cayman Chemical Company, (2014)	Assay Company providing details of services and processes relating to hormonal assaying techniques.	Description of the process involved in different types of hormonal assay
Dasharathy et al. (2012)	Examined menstrual bleeding patterns in regularly menstruating females	Established that in a sample of 201 women over two cycles, menses lasted for five days on average. Increased FSH and progesterone were associated with heavier menstrual bleeding, and higher FSH levels were associated with longer menses. Bleeding duration and volume were reduced after anovulatory compared with ovulatory cycles
Debnath, Prasad, & Bisen, (2010).	Molecular diagnostics.	Provides a detailed description of hormonal assay and other techniques
Ecochard & Gougeon, (2000)	Examined side of ovulation in normally fertile females (199 cycles)	Cycle length and hormonal profile are independent of side of ovulation.

Farage, Osborne & MacLean, (2008)	Reviewed evidence of influence of sex hormones across the menstrual cycle on cognitive, emotional, and sensory function and describes biological process of the menstrual cycle.	Describes the menstrual cycle in detail with hormonal profile for an average menstrual cycle
Fehring, Schneider & Raviele, (2005)	Efficacy of cervical mucus observation with electronic fertility monitoring as a method for natural family planning	Method proved effective in 97.9% of cases.
Gandara et al. (2007)	Examined salivary estradiol and progesterone levels across the menstrual cycle	Concluded that saliva provides an accurate means of measuring estradiol and progesterone levels across the menstrual cycle
Hambridge et al. (2013)	Examined the effects of anovulation on hormone levels in ovulatory cycles	Found that concentrations of estrogen and progesterone were lower in cycles following an anovulatory cycle.
Howards et al. (2008)	Examining the use of fertility monitors on timing of clinic visits	Fertility monitors captured an LH surge in 76% and 78% of menstrual cycles
Jukic et al. (2007)	Examined the accuracy of self-report for menstrual cycle length	Females were found to overestimate cycle length but only by .7 days
Leiva et al. (2014)	Efficacy of simply ovulation detection kits (n = 23)	Simple kits identified Luteal phase in 100% of cycles
Lenton, Landgren and Sexton (1984)	Examined 327 menstrual cycles to identify normal variation in luteal length	Established that a normal luteal phase length is 14.13 days (± 1.4)
McGovern et al. (2004)	Examined instances of false-positive results in LH testing	Found up to 7% false-positive results when simple ovulation kits were used.
Mihm et al. (2011)	Examines the normal menstrual cycle in humans and animals	Provides detailed descriptions of the menstrual cycle with hormonal profile of an average menstrual cycle
Mumford et al. (2012)	Examined menstrual cycle length and hormone profiles and anovulation	Ovulation occurs early in short cycles and later in longer cycles. Short cycles have higher estradiol in the follicular phase and an early rise in LH increasing the risk of anovulation
Nassaralla et al. (2011)	Examined the characteristics of the menstrual cycle following hormonal contraceptive use	Cervical mucus scores were lower for one to two cycles and ovulation occurred one to two days later than predicted for two cycles
Santoro et al. (2003)	Urinary hormonal assessment of the menstrual cycle	Concluded that urinary hormonal analysis provides a robust method of charting the menstrual cycle. Paper provided hormone levels for a regular menstrual cycle.

Scarpa, Dunson & Colombo, (2006)	Examined efficacy of cervical mucus as a marker of fertility	Conclude that cervical mucus examination is an accurate means of detecting fertility. Paper describes the properties of cervical mucus across the menstrual cycle
Small, Manatunga & Marcus, (2007)	Examined the validity of self-reported menstrual cycle length	Report that 21% of sample were inaccurate in reporting their menstrual cycle length
Stricker, et al. (2006)	Aimed to establish reference values for hormones across the menstrual cycle phases using hormonal assay	Established reference values for LH, FSH, estradiol and progesterone across the cycle
Vermesh, Kletzky, Davajan and Israel (1987)	Examined the efficacy of ovulation kits in detecting or predicting ovulation	Established that this method is highly accurate in detecting the LH surge that precedes ovulation (97%)
Wallace et al. (2010)	Examined the effects of menstrual cycle phase on metabolomic profiles of females	Article provides a detailed description of hormone levels across the menstrual cycle
Waller et al. (1998)	Efficacy of urine sampling for hormonal assay of menstrual cycle	Article provides descriptions of menstrual cycle phases in different lengths of menstrual cycle
Wideman, Montgomery, Levine, Beynnon & Shultz (2012)	Assessing the accuracy of calendar based methods (count methods) in assigning menstrual cycle phase	Found the method has some accuracy but recommend using in addition to confirmatory hormonal assay

As Table 1.4 shows, relatively few articles directly focussed on the physical measurement of the menstrual cycle were returned. However, there was a very high volume of articles reporting on research which made use of several of the charting techniques located (e.g. count method and observation of cervical mucus). Many of these papers provided detailed accounts of how each measure was used and although the actual topic under investigation was not always of relevance to the chapter, the papers were included to allow reference to the methodology to be used.

Accurate identification of menstrual cycle phases is important for those wishing to argue that reproductive hormones influence behaviour (see Chapter 3 Section 3.2). As previously stated, there is a lack of consensus regarding which days relate to each cycle phase. Methodology used to pinpoint cycle phases varies from simple count methods (Forward and Backward) to daily hormonal assay

using blood or saliva samples – these are evaluated in Chapter 3. It also includes the use of more invasive measures, such as charting changes in cervical mucus (e.g. Fehring et al., 2005; Scarpa, Dunson & Colombo, 2006). The count method is one of the simplest methods employed by researchers examining the menstrual cycle (Crenin, Keverline & Meyn, 2004; Steiner et al., 2001; Small, Manatunga & Marcus, 2007), however, it is sometimes criticised for lacking accuracy if the count is based on the variable follicular phase of the menstrual cycle (see Chapter 3 Section 3.4.1 for a detailed discussion). When testing takes place in the mid-luteal phase this generally takes place on day 21 or 22. This is accurate in the AMC, however, if a woman's cycle length is longer or shorter than 28 days, testing on day 21 or 22 might not capture the point where progesterone peaks.

Overall the research here suggests that hormonal assay is the most accurate method for establishing precisely where ovulation takes place and when hormones peak and trough over the course of the menstrual cycle (e.g. Farage, Osborne & MacLean, 2008; Gandara et al., 2007). Charting the menstrual cycle with complete accuracy can only be achieved if hormones are measured daily and this is a costly and highly invasive method that is not available to all researchers. Measuring of cervical mucus requires each participant to be trained and is subjective in that it relies on each participant to assess their own cervical mucus and estimate where in their cycle ovulation is likely to occur. Again this is an invasive and time consuming process that some participants may not want to invest in. The method is reliable however and is widely used by women with specific religious as an effective means of family planning (Alliende, et al., 2005; Fehring et al., 2005; Scarpa et al., 2006). Research examining count based methods shows that if the count is based on the follicular phase the method can be unreliable as the follicular phase can vary from cycle. If however, the count is based on the luteal phase which is not variable, the method can be used with some accuracy (e.g. Jukic et al., 2007; Lenton et al., 1984). Research examining self-report methods suggests some inconsistencies with some research suggesting women cannot accurately report on menstrual cycle length. Others

however report that the difference between self-reported menstrual cycle length and actual cycle length differs by only .7 of a day. If hormonal testing is not available to the researcher, then more than one method of measurement can be employed to increase the accuracy of identifying phase (e.g. Wideman et al., 2012). The variation of the days attributed to each menstrual cycle phase will be discussed in detail in Chapter 3. The main research question which will be answered in Chapter 3, is 'what is the best methodology to use in order to have an effective three phase testing protocol?'

1.6.2. Outline of systematic literature review for Chapter 4

This Chapter started from the theoretical position that a much neglected area of menstrual cycle research is the idea of positive changes across the cycle. Much of the current research has a focus on negative mood in the premenstrual phase of the cycle with no consideration of changes to positive mood or indeed well-being across the cycle. As stated, negative changes to mood are well reported however it is reasonable to expect that positive mood also fluctuates across the menstrual cycle. This is informed by the Positive Psychology movement, which takes the view that psychology should not just be about dysfunctional behaviour but should also study the strengths that enable individuals to thrive (e.g. Seligman & Csikszentmihalyi, 2000). Aspects of this are also examined as part of Chapter 2, which takes a qualitative approach to examining attitudes towards, and perceptions of, the menstrual cycle; however the current chapter will examine mood empirically.

Evidence suggests that some females experience changes in mood across the menstrual cycle (Baca-Garcia et al, 2010; Natale & Alberatazzi, 2006), with these changes widely reported in the premenstrual phase (e.g. Attieh Maalouf Richa & Kesrouani, 2013; Cunningham et al., 2009; Hammarback, Damber & Backstom,1989). An initial examination of this literature demonstrated that to date, research has mainly focused on the negative symptoms reported by some females in the premenstrual phase of their cycle (Baca-Garcia et al., 2010; Bertone-Johnson et al., 2009; Cunningham et al., 2009; Natale

& Alberatazzi, 2006). In the premenstrual phase, both estrogen and progesterone levels are low and this suggests that these may influence mood (e.g. Halbreich, Endicott, Goldstein & Nee 1986; Ziomkiewicz et al., 2012). This chapter builds upon some of this work, as it seeks to measure changes in mood and happiness in relation to menstrual cycle phase but will proactively add positive measures of mood in order to investigate this neglected area. This addition is theoretically supported by evidence suggesting that, for example, estrogen can influence positive affect (Farage eta l., 2008; Shors & Leuner, 2003). There is, however, limited research examining changes in positive moods and traits across the menstrual cycle, and so a major aim of Chapter 4 is to address this. As a starting point, a systematic search was carried out to identify research directly relating to the menstrual cycle and positive traits, mood and well-being.

Table 1.5

Inclusion and exclusion criteria for literature review of research relating to the menstrual cycle and mood and well-being.

Parameter	Inclusion Criteria	Exclusion Criteria
Population	Females of reproductive age	Male participants and females outside the reproductive age who do not experience a menstrual cycle
Focus	Menstrual cycle influences in positive psychology and positive personality traits	Referring only to positive psychology or positive personality traits with no reference to the menstrual cycle
	Menstrual cycle influences on positive mood and well being	Referring only to mood or positive traits relating to well-being with no reference to the menstrual cycle
Time period	1980 - 2016	Pre- 1980

Limits were applied to narrow the search including limiting returns to full text online items, peer reviewed items and journal articles. As with previous searches, alternative spellings and phraseology (wellbeing; well-being; mood and affect) were employed to ensure the maximum return. The following terms (Table 1.6) were then used to search within the date parameters.

Table 1.6

Search terms employed during the literature search for Chapter 4.

	Search terms	Results
1	Menstrual cycle phase effects and Positive psychology	35
2	Menstrual cycle phase effects and/on Mindfulness	72
3	Menstrual cycle phase effects and/on Well being	454
4	Menstrual cycle phase effects and/on Mood/Affect	655
5	Hormones and/effects on Mindfulness	30
6	Hormones and/effects on Well-being	5843
7	Hormones and/effects on Mood/Affect	3660
8	O/Estrogen and/effects on Mindfulness	511
9	O/Estrogen and/effects on Well being	3594
10	O/Estrogen and/effects on Mood/Affect	1563
11	Progesterone and/ effects on Mindfulness	249
12	Progesterone and/ effects on Well being	1768
13	Progesterone and/ effects on Mood/Affect	1234
14	Contraception/contraceptives and/effects on Mindfulness	133
15	Contraception/contraceptives and/effects on Well being	756
16	Contraception/contraceptives and/effects on Mood/Affect	272

Very little research directly examining positive traits in relation to the menstrual cycle was returned during the search and this will be extensively discussed in Chapter 4. The more generic search terms (e.g. 'hormones and') had very high return rates and in these instances most of the papers returned were related to hormones and topics not related to the menstrual cycle. The search term 'contraception' returned a high volume of articles not related to mood or the menstrual cycle and this led to a high number of returned items being rejected. Additionally, the search term 'well-being' produced many items that were not related to the menstrual cycle and a high volume of these items were therefore rejected (Figure 1.8).

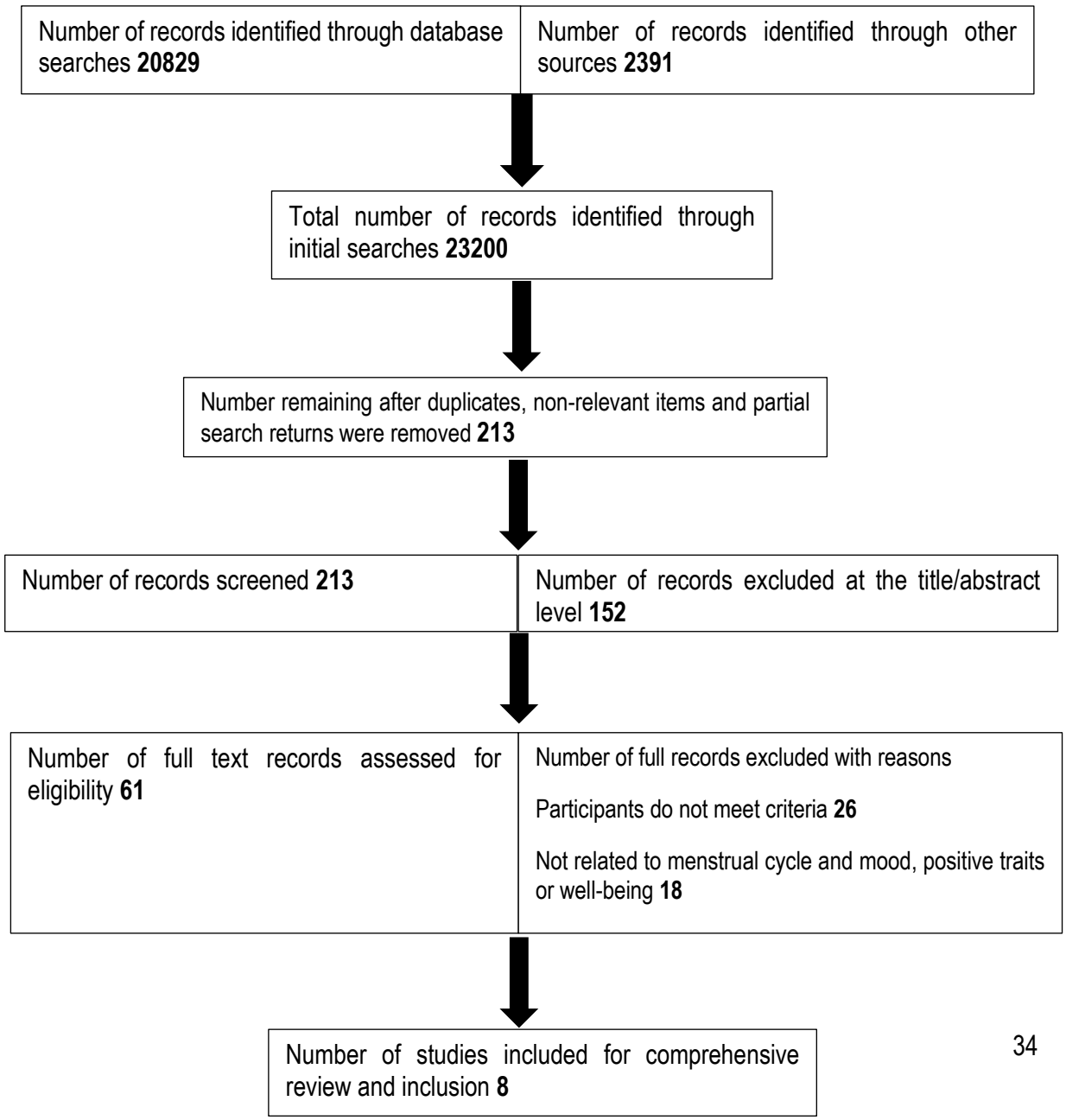

Number of records identified through database searches **20829**
Number of records identified through other sources **2391**
Total number of records identified through initial searches **23200**
Number remaining after duplicates, non-relevant items and partial search returns were removed **213**
Number of records screened **213**
Number of records excluded at the title/abstract level **152**
Number of full text records assessed for eligibility **61**
Number of full records excluded with reasons
Participants do not meet criteria **26**
Not related to menstrual cycle and mood, positive traits or well-being **18**
Number of studies included for comprehensive review and inclusion **8**

Figure 1.8

Flow diagram of literature search for Chapter 4 based on PRISMA guidelines (Moher et al., 2009).

Using this search strategy, eight papers relating to the menstrual cycle and positive traits, well-being and mood were identified as being suitable for inclusion in the chapter. The methodologies outlined in these papers differed with testing taking part daily in some studies and in others, testing occurred in one, two or three menstrual cycle phases. Menstrual cycle phase effects on mood and well-being will be examined in detail in Chapter 4 as well as any effects of contraceptive use on mood and well-being.

Table 1.7

Selection of research studies examining positive traits, mood and well-being across the menstrual cycle.

Author(s)	Topic	Methodology, test phases & sample size	Results
Almagor & Ben-Porath(1991)	OC effects on mood across the menstrual cycle	Self-report via daily questionnaire	OC users significantly higher in positive affect than naturally cycling females [t (54) = -10.58, p < .0001]. This was found for the menstrual phase (F (1, 39) = 7.17 p< .01), the follicular phase (F (1, 39) = 4.00 p <.003) and the ovulatory phase (F (1, 39) = 7.79 p <.01).
Brown (2014)	Well-being across the menstrual cycle	Review article	Well-being peaks in and around ovulation
Brown, Morrison, Larkspur, Marsh, Nicolaisen & (2008)	Overall well-being of women with natural menstrual cycles and OC users	Daily questionnaires over 3 complete menstrual cycles (N = 36)	OC users reported more overall negative well-being than women with natural hormone profiles (p = .038). Positive well-being at mid-cycle was positively correlated with increased sleep by the natural hormone (p < .05) and oral contraception groups (p < .05) but not by the Depo-Provera group.
Davydov, Shapiro & Goldstein (2004).	Effects of menstrual cycle, work and personality on mood	Ovulation kits and hormonal analysis. Follicular (4 - 8 days following menses) Luteal (5 – 10 days after LH surge).	A significant interaction was found for sadness between Hostility (CM) and cycle phase [F (1,35000) = 7.92, P < .005] with higher levels of sadness in the off day compared to the work day in the luteal phase compared to the follicular phase

		Mixed Model design (N = 203)	
Halbreich & Khan (2001)	Role of estrogen in the treatment of mood disorders	Review article	Estrogen may offer a treatment for affective disorders
Lustyk et al., (2011)	Possible relationships between PMS symptoms, menstrual attitudes and mindfulness	Questionnaire study	Moderating effects revealed that mindfulness significantly buffered the relationships between menstrual attitudes and PMSR (β=.45, p<.001)
Munday et al. (1981)	Influences of progesterone, estrogen and aldostyerone on PMS	Hormonal assay. Premenstrual phase	Progesterone significantly lower in non PMS participants in the premenstrual phase p <.05 and estrogen significantly higher in non PMS participants in the premenstrual phase p <.01
Ziomkiewicz, Wichary, Bochenek, Pawlowski & Jasienska (2012)	Temperament over the course of a menstrual cycle	Hormonal assay. Complete cycle	Females high in activity, high in endurance and low in emotional reactivity had up to twice as high estradiol levels and more favourable progesterone profiles as females low in activity, low in endurance and high in emotional reactivity

The search strategy returned articles relating to positive psychological traits, without reference to the menstrual cycle and while they are not presented in Table 1.7 they are included in Chapter 4 for background information. Additionally, studies examining premenstrual syndrome (PMS) are included in the chapter to provide background information, and allow for examination of perceived changes in mood during that phase.

As mentioned at the start of this section, very little is known about the menstrual cycle in relation to positive mood, well-being and positive traits and the small number of articles included in Table 1.10 reflects this. Brown (2014) reviewed the literature, and argued that well-being generally peaks at ovulation. Almagor and Ben-Porath (1991) found that oral contraceptive users had significantly higher self-reported positive affect scores across the menstrual cycle (menstrual, ovulatory and follicular

phases), while conversely Brown et al. (2008) found that oral contraceptive users reported more overall negative well-being compared with naturally cycling females. This suggests that a comparison between naturally cycling and hormonal contraception users would be a useful addition to the literature in Chapter 4.

The role of estrogen in relation to mood was investigated by Halbreich and Khan (2001), who argued that estrogen could be used as way of treating affective disorders, suggesting that it has a role to play in terms of perceived mood. This will be further discussed as part of the discussion within the actual chapter, but evidence from studies outside of table 1.10 suggest an influence of estrogen on positive affect (e.g. Farage et al., 2008; Shors & Leuner, 2003). Studies examining pre-menstrual syndrome (PMS), suggest that both positive attitudes (Lustyk et al., 2011) and hormone levels may be linked to overall mood, with Munday et al. (1981) linking differences between PMS and non-PMS females to differences in both progesterone and estrogen. Only one of these studies (Munday et al., 1981) however used hormonal assay to assess hormone levels; Lustyk et al (2011) used self-report questionnaires. Ziomkiewicz et al. (2012) presents data based on hormonal assay, which suggests that females with a positive outlook or disposition had higher estrogen and progesterone than those who did not. Naturally cycling females are higher in both estrogen and progesterone than hormonal contraceptive users (Noreika, Griškova-Bulanova, Alaburda, Baranauskas, & Grikšienė, 2014), so it might be expected that they will experience greater changes in positive mood over the menstrual cycle that hormonal contraceptive users. Little research comparing these groups other than in cognitive task performance is reported and one aim of this thesis is to examine differences in mood and well-being between these groups.

Davydov et al (2004) used a two phase approach, and found that situational factors (in this case work) had an influence on phase effects, with more negative affect being found in the luteal phase. Ovulation kits and hormonal assay were used in this study to ensure testing took place in the correct menstrual cycle phases. This suggest that the recorded differences in observed behaviour might be related to hormones. Once again, the general but ambiguous link to hormones, particularly progesterone and estrogen, support the current investigation using a three-phase approach with a mid-luteal phase. So the main research question is does mood and well-being change across three phases of the menstrual cycle?

Section 3 Hormonal contraceptive use

1.7 Volitional Control of the Menstrual Cycle via Hormones

Many females choose to control their menstrual cycle using hormonal contraceptive methods. Hormonal contraceptives work by releasing hormones over the course of the menstrual cycle and can contain both estrogen and progesterone or can contain progesterone only (Wharton et al., 2008). Oral contraceptives are taken on a daily basis while other hormonal contraceptives can be administered via injection, implant or patch. The use of hormonal contraceptives means that, for some females, the fluctuations of estrogen and progesterone that women with natural menstrual cycles experience will not be present. Therefore, the behaviour and mood of these females may not change over the course of the menstrual cycle if hormonal fluctuations are responsible as they do for some females with natural cycles.

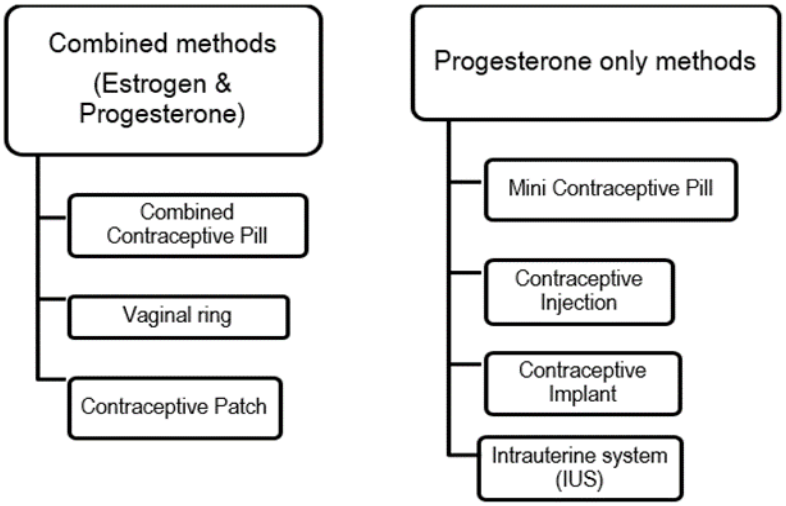


Figure 1.9

Popular methods of hormonal contraception.

Combined Methods of Contraception: The contraceptive pill remains the most common type of hormonal contraceptive prescribed in the UK at present although the popularity of long acting reversible contraceptives (LARC's) is increasing (http://www.ons.gov.uk). The combined pill continuously releases both progesterone and estrogen throughout the menstrual cycle so that females taking contraception should not experience the type of hormonal fluctuation that naturally cycling females do (Fleischman, Navarrete & Flesser, 2010). In addition to this, FSH and LH are not released and this prevents eggs from maturing and being released into the fallopian tubes. The combined contraceptive pill prevents ovulation, thickens cervical mucus (Brunelli et al., 2007; Fleischman et al., 2010; Stanford et al., 2003) and prevents the lining of the uterus from becoming thick enough to sustain an embryo.

Combined Oral Contraceptives (COC's): There are three types of COC's that females can take; monophasic, phasic and everyday pills (Figure 1.13). Monophasic pills contain a consistent amount of hormones and are taken for 21 days with a seven-day break for menstruation. Phasic pills have either two or three different levels of hormones and must be taken in the correct order over 21 days

before a seven-day break for menstruation. As the name suggests the everyday pill is taken for 28 days without a break, however a placebo is taken for seven days so that menstruation occurs. The combination of estrogen and progesterone contained in COC's can regulate the menstrual cycle and produce lighter periods. Newer generation COC's have some anti-androgenetic properties and can reduce and improve the effects of acne. They have also been shown to reduce some of the negative mood experienced by some females and improve complexion in the premenstrual phase of their cycle (Shulman, 2011).

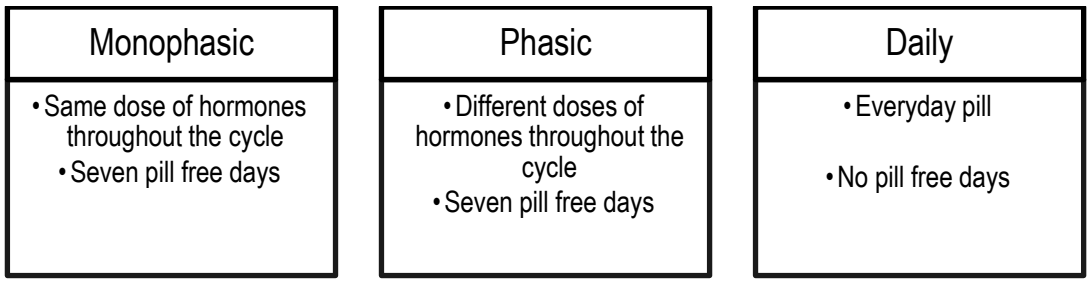


Figure 1.10

Three types of combined contraceptive pill.

Although a popular means of contraception there are risks associated with taking COC's: for example, estrogen has been shown to increase the risk of venous thrombosis and breast cancer (Bitzer & Simon, 2011; Burke, 2013; Hall, Trussell & Schwarz, 2012; Micks & Jensen, 2013). Additionally, COC's are not suitable for females suffering from cirrhosis, liver tumours, high blood pressure, migraines or those who are breast feeding or overweight (Roederer & Blackwell, 2005). Because of these risks, the amount of estrogen contained in COC's has reduced across generations of contraceptives (Bitzer & Simon, 2011), and led to the development of a 'progesterone only' contraceptive pill (Section 1.7). This has not eradicated all of the side-effects; however, the progesterone only pill is believed to carry lower risks than those pills containing estrogen.

Contraceptive Patch: The contraceptive patch is a combined hormonal method that works in the same way as COC's. Users wear a new contraceptive patch each week for three weeks then have

one week without a patch to allow for menstruation, although for some females using the patch, amenorrhea is common. The combination of estrogen and progesterone means that the side effects for the contraceptive patch are similar to COC's (Hall et al., 2012).

Vaginal Ring: This is a small plastic ring that once inserted in the vagina releases estrogen and progesterone for 21 days before being removed for one week. Periods become lighter and although the ring contains estrogen the dose is low and less likely to lead to headache and breast tenderness often reported by females using other combined methods of contraception (Shulman, 2011).

1.8 Progesterone Only Methods

Progesterone-only Pills (POP's): POP's (mini pills) release progesterone which thickens mucus at the neck of the cervix and prevents the lining of the uterus thickening. The type of progestin contained in the pill can differ, although most have gonadotropin inhibiting (preventing the release of FSH and LH) and anti endometriotic (preventing thickening of uterine lining) properties. However, some types of mini pill do not prevent ovulation if they are not taken at the same time every day. POP's also have side effects and have been shown to cause some menstrual irregularities and often cause amenorrhea (absence of menses), however, many females view this as a benefit (Burke, 2011). POP's act on the menstrual cycle in different ways depending on the amount of progesterone the pill contains. High doses tend to supress FSH and LH which in turn reduces the levels of estrogen, while low doses do not affect ovulation but act on the endometrium thinning the lining so that an egg cannot attach (Baird et al., 2003).

Long Acting Reversible Contraceptives (LARC's): LARC's are increasing in popularity with 6.2 % of contraceptive users in Scotland in 2014 choosing them to control their menstrual cycles or prevent pregnancy (www.isdscotland.org). Like POP's these contain only progesterone and as the name suggests are long lasting. Contraceptive injections produce a steady release of progestogen and last for eight to 13 weeks depending on the brand used. Hormonal implants such as Implanon (prior to 2010) and Nexplanon are thin rods that are inserted under the skin of the upper arm. These steadily release progestogen over three years and for many females using these methods, menstruation ceases (www.nhs.uk). The Intrauterine system (IUS) is a t-shaped hormonal coil that is placed in the uterus. Progesterone is released into the womb thickening mucus and preventing pregnancy for three to five years. IUS's lead to lighter, less regular, menstruation and can result in amenorrhea (www.nhs.uk).

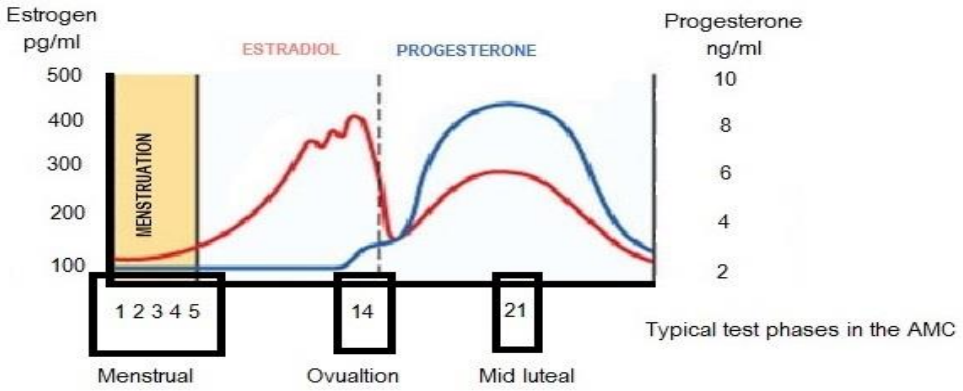
Different generations of contraceptive differ in the dosage of estrogen and progesterone and there is some evidence to suggest that this alone can influence behaviour (Wharton et al., 2008). Females with natural cycles for example, have been found to outperform hormonal contraceptive users on verbal tasks (Griskene & Ruksenas, 2011). Many young females are now choosing LARC's as a method of contraception. As these are progesterone based and prevent ovulation by inhibiting the release of FSH, LH and consequently estrogen, there may be differences in behaviour between them and females using other methods of contraception. Hormonal contraceptive use diminishes the fluctuations of estrogen and progesterone that females with natural menstrual cycles experience. Therefore, the behaviour and mood of these females may not change over the course of the menstrual cycle as they do for some females with natural cycles. In this thesis, where possible, females will be asked about the type of contraceptive they use and if there are sufficient numbers using different generations of hormonal contraceptive then comparisons of behaviour will be made. Where such a

comparison is not possible (e.g. small sample size) hormonal contraceptive users will be treated a single group and their data compared to that of naturally cycling females.

1.9 Progesterone and the Current Programme of Research

It is planned to examine the effects of menstrual cycle phase and contraceptive use on mood and well-being in this thesis. Estrogen effects are relatively well established, however, progesterone effects have been largely neglected, certainly missing the middle part of the phase (mid-luteal) when progesterone is highest, and one aim of this thesis is to address this further (see Chapter 3 Section 3.2). Pilot studies using commercially available ovulation kits in order to pinpoint ovulation (See Chapter 3) will be carried out. This will provide more accurate identification of ovulation and allow for prediction of the progesterone peak experienced in the mid-luteal phase of the cycle (day 21 or 22 in the AMC). This will allow for the development of a novel testing protocol for the current research programme based on the actual length of cycle. The luteal phase of the menstrual cycle has a relatively fixed length (14 days) with peak progesterone levels seven days following ovulation. Once ovulation is detected (should it occur), it will be possible to more accurately calculate testing dates within the mid-luteal phase (Figure 1.16) when progesterone is at its highest.

However, if participants do not have an AMC, testing on these days may not hit peak progesterone levels. Participants in the pilot studies will chart their menstrual cycles and use ovulation predictor kits to establish where ovulation occurs in menstrual cycles of differing length (see Chapter 3 Section 3.4). This will form the basis for the testing protocol to be validated. It is vital for the accuracy of the current thesis to be confident that high levels of progesterone are found when testing in the mid-luteal phase. Participants will be asked to self-report menstrual cycle length and day of ovulation and the timing of the mid-luteal progesterone surge will be estimated on this information (Figure 1.16).



Cycle length	Day of Ovulation (based on cycle length)										Mid luteal Phase (based on ovulation)									
26 days	12										19 – 21									
27 days		13										20 – 22								
28 days			14										21 - 23							
29days				15										22 - 24						
30 days					16										23 - 25					
31 days						17										24 - 26				
32 days							18										25 - 27			
33 days								19										26 - 28		
34 days									20										27 - 29	
35 days										21										28 - 30

Proposed test phases based on menstual cycle length

Figure 1.11

Proposed testing phases based on menstrual cycle length as discussed in Chapter 3.

1.10 Overview of Chapters

Chapter 2 will take a qualitative approach to explore the attitudes of females towards menstruation via a series of focus groups and also investigate perceptions of changes in mood when discussing menstruation. Female responses will be examined to determine female attitudes towards their menstrual cycle (McAra, Wright & Hardie, under review see Appendix 1.2). Male attitudes towards menstruation will also be assessed in order to determine how they differ from female perceptions. Chapter 2 will also discuss recruitment issues to these types of study (see McAra & Wright, 2011: Appendix 1). Chapter 3 will discuss measurement of the menstrual cycle, the lack of consistency in the quantification of days in to menstrual cycle phases by researchers and potential impacts on data. The results of pilot testing for ovulation identification will be discussed here and an empirically tested protocol for determining cycle test phases for the mood and well-being study will be established. As

noted earlier an important aim of this thesis is to examine the effects of progesterone on behaviour, therefore to have a methodology that accurately allows the pinpointing of days when progesterone levels are highest is vital. Currently very little research exists examining the influence of the menstrual cycle on positive traits and well-being so any potential relationships will be examined in Chapter 4. The final chapter of the thesis (Chapter 5) will summarise the key findings, critically evaluate the methodology and discuss both limitations and future work.

Chapter 2: A qualitative analysis of male and female attitudes towards the menstrual cycle

2.0 Overview

This chapter will examine how the menstrual cycle is perceived and experienced by females and how it is perceived by males. Two studies were conducted using a combination of focus group sessions and open-ended questionnaires. Single sex focus group sessions with female and male participants, were conducted separately in a bid to provide a clearer understanding of the influence that attitudes may have on mood and behaviour. The aim here was to examine responses to discover what changes in mood and behaviour females perceive they go through and to examine whether these are shared experiences before quantifiably evaluating these in empirical work (Chapter 4). Male attitudes towards menstruation were also examined using a combination of focus group sessions and open-ended questionnaires. The purpose here was to establish whether the negative attitudes assigned to males by some females in their focus groups were evident in their responses.

Focus Groups: Pilot studies conducted early in the process of developing this thesis indicated a general reluctance of females to take part, and it was felt that an important part of the current research could be to explore this reluctance in more detail. I previously investigated this (McAra & Wright, 2011) and my experience was that recruitment sessions relating to menstrual cycle research worked best when potential participants were invited to group sessions to discuss what the research involves. This naturally led to a discussion about the menstrual cycle, with many females relating their own experiences to one another. Females in this pilot work were enthusiastic about the research, asking questions and expressing willingness to take part. These results suggested focus groups might be a

useful way to investigate attitudes towards menstruation and so were included as part of the current research project.

Qualitative methods have proved successful in encouraging participants to talk frankly about their experiences and attitudes so it was hoped that females and males would be willing to take part in these sessions. Previous research (e.g. Ross et al., 2003; Sassoon et al., 2011) reports that some women perceive changes to their mood and personality over the menstrual cycle and a focus group setting allows these perceptions to be examined in an informal way. Narratives have also provided insight into females' views on, and experiences of dealing with menstruation in social settings (Allen & Goldberg, 2009; Burrows & Johnson, 2005). Focus groups are a popular and useful way to explore females' experiences of menstruation while allowing them to interact and to share their experiences (Burrows & Johnson 2005; Settles, Pratt-Hyatt & Buchanan, 2008). By the same rationale, males may feel more comfortable in the company of other males when discussing an issue that they are not usually asked to discuss. It has been suggested that providing a naturalistic setting shifts the power away from the researcher to the participants, allowing the researcher to examine how participants interact and construct meaning to their shared experiences (Wilkinson, 1999). Such interactions can produce information or insight that might not otherwise be found. Therefore, the focus group method was chosen as it allows the simulation of everyday conversations and allows the examination of how females and males create meaning and reach an understanding when in a group setting.

Online questionnaire: Recruitment of males willing to take part in focus group sessions discussing the menstrual cycle proved difficult and it was decided to also put questions into questionnaire format and allow males to answer them anonymously. Questions were slightly altered from the focus group questions but the order remained the same (see Appendix 2. 2). In focus group sessions, the facilitator

encouraged participants to expand on their answers, therefore in the questionnaire respondents were prompted to give as much detail as possible for each response.

Study 1. Female attitudes towards menstruation

2.1 Introduction (Female participants)

Historically menstruation has been viewed in a largely negative manner. This negativity was mainly focused on the external, with menstruating women being regarded by men as dirty or evil, and who should be shunned or kept hidden from the world. From Mesopotamia, Ancient Egypt and Roman times, carvings, papyri and scrolls and the bible offer evidence that women who menstruated were shunned and thought of as unclean (McAra & Wright, 2011). In the last few decades however, negativity related to the menstrual cycle appears to have become more internalised, with women themselves expressing feelings of disgust or shame (Fahs, 2011, Roberts, 2004). The norm is for menstruation to be portrayed as something that women should manage discretely and quietly. In other words, women are expected to follow menstrual etiquette. This etiquette dictates how women should speak about menstruation and how they should hide it from others (Laws, 1990). Young (2005) argues that living within these rules creates an emotional and disciplinary burden for women and that this burden enforces the feelings of shame experienced by many and these feelings can remain with the woman in the long term.

Feminist researchers have long discussed feelings of shame relating to the menstrual cycle arguing that it is how menstruation is constructed that creates these feelings. de Beauvoir, (1952 cited in Young 2005) referred to menarche as a crisis for girls, while others use terms such as 'traumatic' (Koff, Rierdan & Jacobson, 1981) or 'disruptive and confusing' (Ruble & Brooks-Gunn, 1982). Feelings of

disgust or shame can lead women to have negative attitudes towards other aspects of their lives including their sexuality. Women who feel menstrual shame can be less assertive in terms of their sexuality and may be more likely to expose themselves to sexual risk (Schooler, Ward, Merriwether & Carruthers, 2005).

Much of the current research on the menstrual cycle is concerned with the negative impact it has on females (Baca-Garcia et al., 2010; Wright & Badia, 1999; Natale & Alberatazzi, 2006), and a positive approach to menstrual cycle research can be unexpected with females surprised to be asked about positive aspects of their menstrual cycle (Choi & McKeown, 1997). Responses can be influenced not only by the approach adopted by the researcher but also by the tools employed and these can prime a negative response. For example, questionnaires such as the Menstrual Distress Questionnaire (MDQ, Moos, 1968) and the Menstrual Attitude Questionnaire (MAQ, Brooks-Gunn & Ruble, 1980) focus on mainly negative aspects (pain, water retention, negative affect) of the menstrual cycle (Delaney, Lupton & Toth, 1976; Ussher, 1989) and the title alone may prime a negative response (Marvan, Ramirez-Esparza, Cortez-Iniestra & Chrisler, 2006; Rose, Chrisler & Couture, 2008). Delaney et al. (1988) devised a questionnaire called the Menstrual Joy Questionnaire (MJQ) asking about positive menstrual experiences. Although the questionnaire itself was criticised for lacking validity and reliability when student participants could not agree on the definitions of scale items (Heard, Chrisler, Kimes, & Siegel, 1999), it did help participants to consider the positive aspects of menstruation leading them to regard menstruation differently (Chrisler, Johnston, Champagne & Preston, 1994).

Attitudes towards the menstrual cycle can also be influenced by a variety of factors including the way a mother deals with her daughter at menarche (Costos, Ackerman & Paradis, 2002; Lee, 2008; Marvan & Molina-Abolnik, 2012; Ozdemir, Nazik & Pasinlioğlu, 2010). Studies in the seventies and eighties

examining the role of mothers at menarche found girls were often encouraged to feel shame and embarrassment (Delaney et al., 1988; Golub & Harrington, 1981); however, a more open attitude towards menstruation over the last 40 years has seen attitudes shift in a more positive direction. Emotionally engaged and supportive mothers have been shown to foster positive attitudes towards menarche and menstruation in their daughters (Beausang & Razor, 2000; Lee, 2008). This is beneficial to girls as a positive experience of menarche is associated with a positive body image, more positive health behaviours and a positive attitude towards menstruation later in life (McPherson & Korfine, 2004). However, there are few contemporary studies examining female's feelings towards menstruation and the current study is an excellent opportunity to see if the current position reflects a more positive attitude.

2.2 Method

In the following study using the focus group method, females were asked a series of semi-structured, open-ended questions (covering positive and negative experiences) about their experiences of menstruation.

Participants: Females over the age of 18 years were invited to take part in the study. All participants were recruited from students and staff at Abertay University. In order to avoid any discomfort and to help keep the exchanges naturalistic, each group was made up of females who were friends and/or classmates. A total of 24 females (mean age 26.9 years) took part.

Procedure: A total of eight focus groups were conducted. These comprised of two, three or four respondents plus the researcher acting as facilitator. All sessions were held in a quiet laboratory in the psychology division. The equipment used for video recording was a Panasonic Network Camera Recorder with Viewer Software – Single Camera Version 3.06RO1. This was wall mounted behind

the facilitator and the sessions were recorded on a secure computer. A microphone was placed on the table in the middle of the room and an Olympus WS - 450 S digital voice recorder was used to record audio as a back-up should the camera malfunction. Respondents sat in a semi-circle round a small coffee table facing the facilitator and camera. At the start of each session the facilitator explained the purpose of the focus groups and reminded the females that they would be videotaped and audio recorded. Participants were informed that they could leave at any time during the session without explanation. The facilitator explained that videotaping was being carried out to allow for accurate transcription of conversations and that following transcription, video and voice recordings would be destroyed and data anonymised. For that reason, once transcription and anonymisation was complete, data could not be removed. The females were also informed that another researcher (project supervisor) was monitoring the camera and would start and stop the recording. At this point females were again asked if they were willing to give their consent if they were willing to take part.

To start the conversation, the facilitator introduced herself and spoke a little about the research then asked the females to say a little about themselves. This was based on an introduction suggested by Stewart and Shamdasani (1990). Once introductions had been completed, the first of eight open ended questions were asked. The first question asked what females consider as negative in terms of menstruation in order to start the discussion. This was based on experiences of group discussions with females whilst recruiting participants and a personal belief that a question about negativity would lead to discussion and help females to become comfortable with each other. To ensure continuity the questions were asked in the same order in each of the sessions (Appendix 2.1). During the sessions, the topic of conversation occasionally moved away from the question response and these conversations were not curtailed in any way. The facilitator allowed these discussions to extend and waited for them to come to a natural end before returning to the structured questions.

These questions were: 1) Some people regard menstruation in a negative way. Can you tell me about any aspects of your menstrual cycle that you think of negatively? 2) What aspects of your menstrual cycle can you think of that are positive? 3) How do you feel about discussing your menstrual cycle in this type of setting? 4) Have you ever been asked to take part in any research examining the menstrual cycle? 5) Do you have any suggestions as to how females might be encouraged to take part in research into the menstrual cycle? 6) I am running a study which asks participants to use ovulation kits but have found that participants are reluctant to take part. Why you think this might be the case? 7) What would encourage you to take part in this type of study?

In line with the methodology of Burrows and Johnson (2005) during each session the facilitator gave a narrative account of a personal experience about menstruation. This was a personal narrative based on an event witnessed in high school. The facilitator recounted witnessing a girl who had started her first period being surrounded by other girls who were offering help and support as well as hiding her from the view of others. Although a comment was made about seeing blood on the girl's legs the emphasis of the story was the solidarity shown by other girls. The narrative was not given at a specific time during sessions but given when appropriate or when there was a break in conversation. The intention was that by relating a personal experience, the females in the group would feel more comfortable sharing and relating their own experiences of menstruation.

Sessions varied in length from 27 minutes to 49 minutes and at the end of each session participants were thanked for their time and reminded that following transcription of the data all identifying factors would be removed.

Focus group conversations were transcribed verbatim with respondents identified only by their initials. Once transcriptions were complete respondents' initials were replaced with pseudonyms. As suggested by Luborsky (1994) narratives were closely read without taking notes to allow the researcher to get a feel of the experiences of the women. A simple thematic analysis was carried out to identify themes such as disgust and to examine any emergent themes. A grounded theory approach as suggested by Strauss and Corbin (1990) was used. Transcripts were initially read and re read before open coding was carried out for each research question. The open coding identified themes based on the words used in the responses to questions asked in the focus groups and questionnaires. Once this had been carried out axial coding was carried based on relationships found between the open codes. Finally selective coding was carried out to identify common themes based on the axial coding before transcripts were recoded again within the final themes.A total of four themes emerged from the transcripts (Table 2.1). These separate themes were then examined again to identify where synonyms of specific words were used and these narratives were also included. For example, in the disgust theme words including grotty, dirty and yuck were considered as related but importantly, this was context dependent, and any uses not directly related to menstruation were omitted.

Table 2.1

Themes and subthemes generated from the female focus group

Theme Name	Sub themes
Menstruation as disgusting	Feeling dirty Disgust of others
Menstrual misconceptions	Timing of ovulation Menstruation means fertility
Menstruation as shameful or embarrassing	
Positive aspects of menstruation	Good reproductive health Natural function

2.3 Analysis and Discussion

Theme 1: Menstruation as Disgusting. This theme represents the phrase that was most often used by females when asked about menstruation. This includes the elements that females most commonly considered made them feel disgust.

One of the most common terms used by females to describe their experience of menstruation was disgust. This was directly expressed with many females actually using the word disgust, and indirectly when females talked about how menstruation made them feel disgusted because it made them feel dirty. Gender differences in disgust sensitivity have been shown with females being more sensitive to disgust than males (Borg, Lieberman & Kiehl, 2008; Haidt, McCauley & Rozin, 1994; Holstermann, Ainley, Grube, Roick & Bögeholz, 2012; Rohrmann, Happ & Quirin, 2008; Skolnick, 2013; Skolnick, Bascom & Wilson, 2013) and this may be a contributing factor in the focus of much of the discussions.

Sub-theme: Feeling Dirty: Disgust can be defined as a strong feeling of revulsion that can be accompanied by nausea or a desire to withdraw from what is causing the feeling (Oaten, Stevenson & Case, 2009). The word disgust or disgusting was used to describe menstruation 27 times across the groups by 10 individuals while the word dirty was used 13 times by six individuals as a way of describing why they felt disgust. Disgust was used to describe menstruation in six out of the eight sessions. Typically, one woman would say something about disgust and the other females in the group would agree. The conversation would then move to why females felt it was disgusting or females would describe an experience related to menstruation that they felt made them feel as if they were disgusting.

> **June** I suppose…it does make you feel like a woman, but it does make you feel grotty. You know you feel like you're dirty all day. [Agreement from group] you know you have a shower

in the morning and in the evening and you can still feel pretty dirty and it's just disgusting in that respect.

Sheila I think that anything that comes out of your body is seen as dirty maybe? And anything that goes in is…well ideally clean [laughs] cos in our country bloods seen as bad and dirty and…you can get a disease from it

Denise dirty…disgusting…horrible

FACILITATOR do you think it's a dirty thing then yeah? Is it that…that feeling of being unclean?

Denise yeah it would make you feel like…especially if it's really heavy and you know it makes you feel like…it's not nice…it's just not generally a very nice thing is it…you just don't really speak about it cos it's just dirty

Once this type of comment was made the speaker would look to the others in the group for their views. Typically, even when females had initially made a more positive comment, once disgust had been mentioned the discussion became very focused on what was perceived to be disgusting about menstruation. Media tends to construct menstruation negatively and has been accused of portraying menstruation as a "hygienic crisis" (Erchull, Chrisler, Gorman & Johnston-Robledo, 2002; Schooler, Ward, Merriwether & Caruthers, 2005), or as something to be managed and hidden (Kama & Barak-Brandes, 2013; Laws, 1990). Constant exposure to such negativity effectively socialises females to expect pain and irritability (Woods, Mitchell & Lentz, 1995), and have negative expectation about menstruation (Klebanov & Jemmott, 1992) and this may contribute to the negative attitudes demonstrated by focus group participants. In conversation it became clear that some women perceive menstrual blood to be different from venous blood and it is this perceived difference that may drive these feelings of disgust.

Hazel sorry …that's totally disgusting…I don't think it's like real blood …well it is cos it's blood obviously. **Elizabeth** clots…is it not more lining? **Hazel** yeah…sticky and…

Sub-theme: Disgust of Others: The disgust females spoke of was not always felt by them personally and for some it was their perception that males were disgusted by menstrual blood. In films menstruation has sometimes been portrayed as something which is revolting or disgusting (Kissling, 2002). For example the film Superbad shows the male characters to be horrified at the sight of menstrual blood (Mottola, 2007). This type of male reaction is commented upon by one woman who cannot understand why her boyfriend feels such disgust.

Lesley right…like if I like say just cut myself on my arm…my boyfriend can look at the blood on my arm … but if its blood down there he's like yuck …yeah…it's just the same blood…so…

Laura I think they think that the blood is…the blood is mixed…mixed with something that is like …like rest…or you know wastes [sic] or something like that…

This exchange confirms that for some females menstrual blood is perceived as being unnatural which strengthens the perception that it is dirty and should be hidden (Johnston-Robledo & Chrisler, 2011; Kama & Barak-Brandes, 2013). Women's narratives about menstruation often relate to a fear that menstrual blood might leak through their clothing leaving them embarrassed or ashamed (Oxley, 1998). Chertok (1969, cited in Moore, 1995) suggests women may associate menstrual blood with other bodily excretions such as faeces and this may be the basis of their disgust and one participant does make this comparison.

Molly I just think it's like well… if you wet yourself or something… well you wouldn't want anyone seeing that would you? [Agreement from group]…kind of on the same lines…

In three of the sessions, menarche was discussed in mainly neutral or negative terms with only one participant expressing joy at the experience of becoming a woman. However, her joy was tempered by negative responses from family members which resulted in her becoming negative about the experience.

> **Anne** I don't know like I was a late… like I was a 15 when I started my periods so… my mum died when I was 6 and my dad was basically a drunk right so it was my gran that did it. I remember saying to her [whispers] "gran I've started my period" and she was like "[name of respondent] dinnae (don't) tell me"…well who am I gonna [going to] tell? She went "fuck, tell [name]". So she was my sister so I was like "[names sister] I've started my period" and she was like "what are you telling me for?" and I thought I was great… I was start…everybody had periods except me and I just wanted to "yeah I've started…" that never lasted long – that good feeling I'll tell you.[laughter from group]

This emphasises the importance of someone who provides a positive or supportive role and lends weight to the argument that a negative response can lead to a negative attitude to menstruation in later life (Beausang & Razor, 2000; Lee, 2008; McPherson & Korfine, 2004)

> **Lesley** no [laughs]…I hate them…like…well when I was younger before I got my periods and my mum always got hers and I was like oh wish I had my periods and then the minute I got them I was like nooo and my mum was like "see … see you shouldn't have wished for them" [laughter] one of my friends was always like "I'm just gonna [going to] get a hysterectomy that's it"

For one woman feelings of disgust prevented her from telling her mother her period had begun. In fact she states that her mother "found out" rather than being told.

> **Chloe** it was the most horrible disgusting thing and I was greeting [crying] in the toilet and stuff…and I think I had at least two [periods] before I…or even three and then she found out…

How mothers discuss menarche with girls can influence how they perceive their menstrual cycle in later life (Marvan & Molina-Abolnik, 2012; Ozdemir et al., 2010). Feminist researchers argue that it is how menstruation is constructed that creates these feelings (Koff & Rierdan 1995; Liu, Chen & Peng, 2011; Ruble & Brooks-Gunn, 1982). At menarche an emotionally unavailable mother may cause her daughter to associate feelings of shame and humiliation with menstruation (Lee, 2008). Young (2005) argues that because girls are not prepared for menarche they feel a range of negative emotions like, shame, fear and disgust and this can have implications for later life. "Midlife" women (aged 40 - 65), when asked about menstruation will tend to use terms such as messy, dirty or annoying to describe it. The research shows that menstruation continues to be constructed as something overwhelmingly negative and as something that should be hidden and not discussed openly (Braun & Wilkinson, 2001; Kissling, 1996). Feelings of disgust or shame towards menstruation can correlate with negative attitudes towards other aspects of their lives including sexuality (Schooler et al., 2005). Negativity towards menstruation has been shown to cause females to think negatively towards other reproductive aspects of females' lives such as breastfeeding (Johnston-Robledo, Sheffield, Voigt & Wilcox-Constantine, 2007) and childbirth (Moloney, 2010).

In all but two of the groups when the discussion focus was disgust, this was the perceived disgust of other people. The "others" females were concerned about were not only males, but other females including friends and colleagues. Similar to Burrows and Johnson (2005), when females talked about their school days "others" were male and female class mates but when talking about their adult experiences the "others" discussed tended to be male friends or acquaintances. In both cases the fear expressed was of what others would think of the females if their menstruation was apparent. Johnston-Robledo and Chrisler (2013) note that although society on the whole no longer regards menstrual blood as toxic, good manners dictate it should be concealed in public and in private. Indeed, the females in the focus groups were clear about why their menstruation should be hidden from others.

Lesley mm…you would think people…people would think you were disgusting because you've got blood coming out of you.

Again here the disgust is related to menstrual blood and in three of the sessions sex during menstruation was discussed. For many females, menstrual sex is thought of as something to be avoided with some females describing it not only as messy but as disgusting or unhygienic (Fahs, 2011). In two of the groups this was done in a jocular fashion with the females noting that menstruation could be used as a way to get out of sex but in one of the smaller sessions two females discussed sex during menstruation focussing on the disgust expressed by their male partners.

Lesley mm yeah and no…I mean there's been times when…I only see my boyfriend at the weekends because I'm here [university] …I met him when we were back home…and if I'm in the mood you know and I'll say to him can you do something and he's like [screws up face with look of disgust] but you're bleeding and I'm like "so; it cleans" but he's like…he just thinks it's disgusting going anywhere near me down there when I'm bleeding.

Laura it's so funny… when I met my husband…when we were just going out erm…he didn't mind to have intercourse with me when I had my period but nowadays…he can't even see…when he perceives that I have my period he feels like when he goes to the toilet he never open the bin because he finds something over there that's red… it's so funny how he changes… I ask him the other day…why do you change because…when I have my period I'm also feeling ... you know, and he's always saying … no, no blood…but you used to like!... you didn't mind before. Why is that now? No, no, no it's just disgusting he can't even say why.

This narrative is interesting in that sex during menstruation was initially enjoyed by the couple prior to marriage, yet the male is now against the idea but cannot or will not say why he now regards this as disgusting. Allen and Goldberg (2009) found that fewer than half of the female college students in their sample engaged in sex during menstruation. Females and males reported trying menstrual sex

but found the experience unfavourable citing discomfort and mess as the main reasons they would not try this again. Males who had not had sex with a menstruating woman reported that mess would dissuade them while one male was concerned the female would be uncomfortable. Fahs (2011) reported similar results with fewer than half her sample making positive comments about menstrual sex while the remainder referred to the mess created or to bodily discomfort or shame.

One respondent discussed a male friend who claims a menstruating woman can be identified by smell. She found this disgusting and felt she should avoid him when she is menstruating even though she is unsure if she actually believes him. Although the evidence for sex differences in odour detection is conflicting, females are thought to outperform males for detection and identification of odours (Doty & Cameron, 2009). Perhaps in this case it is the woman's own sensitivity to odour that causes her to question whether this male can detect her menstruation.

> **Elizabeth** well I've got a guy friend who says he can smell when a woman's on her period … yeah he says he can always tell when my female friends are on their period … and that's like that's disgusting…so I don't like seeing him [laughs] cos that's wrong…I don't know if I believe him.

The perception that menstruating females smell somehow unclean continues to be discussed by both males and females. Thornton (2013) thematically analysed tweets related to menstruation and in addition to negative stereotyping about menstruating females found that negative comments came from both male and female tweeters about how menstruating females smell and what they should do to mask their scent.

***Theme 2: Menstrual misconceptions*.** During conversations it became clear that there was some confusion about what menstruation and ovulation were.

Sub-theme: Timing of Ovulation: During the sessions a number of the females began to talk about specific phases of their menstrual cycles. It became clear during these discussions that a number of the females lacked knowledge about some of the processes involved in their menstrual cycle and for a few of the females there was confusion about when ovulation took place. This supports evidence suggesting that many young females lack basic knowledge about the menstrual cycle (Houston, Abraham, Huang & D' Angelo, 2006; Cohn & Richters, 2013; White, 2013).

> **Lauren** is it before you have your periods that you ovulate? **Hazel** I don't know…I thought it was like three days before my period
>
> **June** ...and I think it's…you know you ovulate; you just don't know when. I know I go through four stages of sleep but I don't know when…

Moore (1995) notes that girls will often share misinformation and this can lead to a distorted idea of the connection between menstruation and pregnancy. Where they have gaps in their knowledge they will include myth and this can increase any anxiety they might have about menstruation. Young (2005) argues that girls want the practical details about menstruation rather than the technical or biological details. They want practical advice on how to avoid leaks, or as to which product is best to use or how often pads or tampons should be changed rather than what ovulation means and when it occurs.

Sub-theme: Menstruation Means Fertility: Several women in the groups associated monthly bleeding with reproductive health showing what seemed to be some confusion between what ovulation and menstruation mean. Indeed, for females in five of the groups this 'sign of fertility' was what they regarded as the only positive aspect of their menstrual cycle. Burrows and Johnson (2005) also found that when females were asked about positive aspects of their menstrual cycle, they tended to reply in terms of reproductive health with females regarding menstruation as a sign of fertility.

Jane no... I think… just a monthly reminder that you can still have kids. **Mary** yeah, yeah, that's about it. **Laura** yeah you can have babies. **Chloe** I know another pos…well I suppose a positive thing is that you can have children…you know you're getting a period you're getting a proper…[gestures in circular motion] and you want children, that's a positive thing … then you know that at one point if you want to …well hopefully if there's no complications and stuff.

Sharing misconceptions about menstruation can lead to a distortion of the link between menstruation and pregnancy (Moore, 1995). In focus groups where females stated menstrual bleeding was a sign of reproductive health, there was broad agreement from the others in the group. It is unclear why some females hold the belief that menstruation itself indicates fertility. Some mothers at menarche tell girls that now they are menstruating they can become pregnant and it may be that this is misinterpreted. If no reference is made to other phases of the cycle e.g. ovulation, they may lack a complete understanding of what the menstrual cycle entails.

Theme 3: Menstruation as shameful or embarrassing: Many of the participants discussed the embarrassment they felt in relation to different aspects of menstruation.

Narratives about school were focused mostly on how as girls participants had kept their menstruation private; a practice which continues for many into adulthood (Burrows & Johnson, 2005; Erchull et al., 2002; Jackson & Falmagne, 2013; Simes & Berg, 2001). Discussions focussed on concealment of menses and the embarrassment which would be experienced had others (boys and girls) seen evidence of menstrual blood. The most common word used to describe these feelings was embarrassment although words such as mortified or horrified were also used to convey embarrassment. Over the eight sessions 'embarrassed' was used 43 times by 16 different females and in many of the cases this was related to others knowing the woman was menstruating.

Chloe …yeah is it going to show through your clothes and that? [Agreement from group]. Now I wouldn't bother…now I'm not so worried…but when you were...when you first started then that was a huge… **Hannah** and **Amy** [together] yeah… **Chloe**…worry

Memories of dealing with menstruation in school were widely discussed with most women in the groups relating their personal experiences.

Hannah yeah going to class…always for the whole week you'd be so paranoid. Two pairs of pants for the whole week. **Chloe** yeah…you'd go in class and you think …you know its high school and you're paranoid and…

Hazel you know what it's like…see even in high school when you got caught out and you went to the office…you were like slipped something so…so slyly it was…what…you know it's not like people don't realise why I'm here…you know what I mean?...

Elizabeth oh my God…I did that when I was at school…I got up and it was on the chair…I was mortified…I don't think anybody noticed… but I was mortified.

Many of the females when reflecting suggested that school was where the secret really needed to be kept and a number of lengthy conversations concerned how concealment was managed. Adolescent girls' attitudes towards menstruation is mainly negative (Koff & Rierdan, 1995; McPherson & Korfine, 2004) and it appears that the shame of being discovered does not reduce with time. Although menstrual products are now advertised more overtly than historically, sanitary products continue to promote the notion that menstruation should be hidden (Chrisler, 2011; Jackson & Falagne, 2013; Kama & Barak Brandes, 2013). For some of the females in the focus groups, concealing their menses clearly remains a priority.

June …and you know what I do? I…this isn't…I wear two pairs of knickers...so I have one with the pad on and then another pair of knickers to keep it all in place cos it moves around

> too much if I don't …and I know it sound ridiculous but then also what I do is that I put an extra pair of knickers on over tights to make sure the tights stay up cos I hate it when they go down…so if I've got my periods and I'm wearing a skirt, I've got three pairs of knickers [laughter from group] so if I get hit by a bus I'm like well what will they think…[laughter from group]…so yeah…that aspect of it. But it just makes me feel safer you know. I'm all contained…all contained, so if it leaks, I have it all…you know I have an extra layer before there's a disaster… [Laughter]

Despite the laughter there was broad agreement with the precautions taken and the use of the word *disaster* here indicates just how strongly this woman feels about concealing her menses. The shame attached to being exposed as a menstruating woman may seem somewhat extreme, however, research suggests that people can and do react negatively towards menstruating females. For example, a woman who drops a tampon from her bag is regarded as someone to be avoided by both male and female students and thought of as less competent when compared to a woman dropping a hair clasp (Roberts, Goldenberg, Power & Pyszczynski, 2002). Males and females have also been shown to rate menstruating females as more neurotic, more irritable and sadder than non-menstruating females (Forbes, Adams-Curtis, White & Holmgren, 2003).

Theme 4: Positive Aspects of Menstruation. Many of the females spoke about how menstruation was reflective of good reproductive health.

Sub-theme: Good Reproductive Health: Although the narratives tended to be quite negative, females were also asked about any aspects of their menstrual cycle they regarded as being positive. Many of these answers were framed in terms of fertility or health with a number expressing relief they would be able to conceive or relief they had avoided pregnancy.

Amanda well if you're having a period then it means everything's…it's all working isn't it? … Everything's still going…you're still quite healthy… **Hannah** definitely the good thing about periods is you know you're not pregnant [laughter and agreement from the group].

Sub-theme: Natural Process: One of the females noted that despite of all of the negatives she was happy when she had her period and out of all of the female groups she was the only woman to refer to menstruation as natural.

Laura I like to have my period…because I just feel like its natural it's something like… I feel like every time my blood comes I feel like I'm clean inside.…so your period or the time that you have blood…the opposite time of the month is when we are…when we are ready…I feel more lovely…more much more…my husband when he comes I feel…you know I think if we didn't have the period then we would feel the same all month you know…

For some females, menstruation continues to be thought of as a natural event but this is changing. Increasing numbers of females are seeking to suppress menstruation particularly in Europe and the USA with many females expressing a preference for suppressing menstruation completely (Andrist, et al., 2004; Hitchcock & Prior, 2004; Kantartzis & Sucato, 2013; Lakehomer, Kaplan, Wozniak & Minson, 2013). Gunson (2010) argues that what females regard as natural and what is safe in terms of menstruation has become somewhat confused. She notes that when considering the use of menstrual suppressing contraception, females are not concerned about what is natural about their menstrual cycle. The choice for many females to supress or alter their menstrual cycle is based on practical issues such as avoiding pain or mess (Andrist, et al., 2004; Lakehomer et al., 2013) as well as for the obvious contraceptive role.

For some of the females one positive was being able to avoid sex and generally when this comment was made there was laughter and agreement from the other females. For many females this is a

common excuse for avoiding sex and is regarded as a legitimate reason for abstaining (Delaney et al., 1988; Thornton, 2013). In one of the groups however there was a single reference to a positive emotion.

> **Anne** you get pissed [drunk] really quick [laughter from the group] …well I do … seriously no…I take a couple of drinks and I'm whoa, you know …you know cheap night tonight [laughter]… yeah and as soon as I get them I'm so happy it's unbelievable… because it's just like…it's just like that, relief [agreement from group].
>
> **Alison** yeah, yeah I would say that…yeah I think the positive is the re…the kind of almost like a release.

Other than this the remaining comments relating to the positive aspects of the menstrual cycle related to reproductive health and following this discourse the females in the groups very quickly returned to talking about what they felt was negative about their cycles.

The return to negativity may be a reflection of the menstrual cycle phase participants are experiencing. It seems plausible that an individual who experiences premenstrual symptoms or who is suffering menstrual cramps will feel more negative towards the menstrual cycle during those phases. In all of the groups there was a pause before anyone replied to the positive question which may indicate surprise at being asked to consider positive aspects (Choi & McKeown, 1997). If no positive aspects were mentioned the conversation quickly reverted to the perceived negatives. Where positive comments were made, very little time was spent talking about them before the females returned to talking about more negative feelings.

> **Kate** erm…this is silly…but erm …right…right beforehand…before I start my period I maybe eat more you know chocolate and stuff…but see like in that actual week like…I don't think I eat as much…well I feel like I don't eat as much…I think it's maybe the bloatedness

goes away or something … yeah but I always feel a bit better…don't eat as much. I don't think there's that many good things

Participants were also asked where they felt most comfortable talking about their menstrual cycle experiences and there was consensus that a small group setting in a relaxed atmosphere was ideal. This built upon previous experiences from anecdotal and ad hoc conversations with students regarding this issue. When asked why this was the case, females responded that they liked sitting with other females talking about something this is unique to females. The setting allowed them to say what they wanted to say comfortably. Menstruation is experienced by most females in their lifetime so females feel comfortable talking to each other.

Stephanie it feels like we're allowed to talk about it in here though. You know what I mean though? Cos we've all come here thinking, oh that's fine I'm going to talk about it and everybody's on the same wavelength and nobody's going to be like "oh I can't say that" whereas when you're out in other kind of groups and you're not so sure where everyone's boundaries are…sort of like a taboo thing you know.

2.4 Limitations

Asking females to split experiences of menstruation into positive and negative has been criticised as simplistic (Burrows & Johnson, 2005), and it may be that the manner in which females are asked about menstruation primes their response. In these sessions negative issues were raised first with the belief this would provoke a response and encourage discussion. The strategy was successful, however it may have been naïve and may have primed participants to focus on negative experiences in the same way that negatively named questionnaires can produce negative responses (Rose et al., 2008). It may have been judicious simply to ask participants to relate their experiences without making any reference to the terms positive or negative. Qualitative methods may be useful for gaining insight

into females' perceptions of menstruation but perhaps future research should give more thought to how the conversation is initiated in order to avoid narratives becoming too biased. Females struggled to find positive aspects relating to menstruation worthy of discussion and this may be related to the order in which the questions were asked. Of the 24 females who took part in the focus groups, only two said they had never experienced any menstrual problems and only one woman referred to menstruation as being natural. When describing a personal memory of school and a young girl at menarche I was careful to stress the solidarity shown by the girls in the playground, however, women in the sessions tended to focus on the visual aspects. The mention of seeing blood seemed to cause females in the group to recollect how they concealed menses not only as girls at school but as adults in their everyday life. Future research should take this into consideration and perhaps facilitate away from the visual aspect if participants seem to become too focussed on this. However, care would be needed to ensure this did not disrupt the natural flow of the conversation.

2.5 Conclusions

Despite the passage of time and the more positive approach taken by many researchers, menstruation remains something that is constructed negatively leading to females considering it in mainly negative ways (Jackson & Flamagne, 2013; Johnston-Robledo & Chrisler, 2013). This was true for the women who took part in the sessions and, similar to Choi and McKeown (1997), surprise was expressed when these women were asked for positive thoughts about their menstrual cycle. Had menstrual cycle phase been recorded responses from females in different phases could have been compared. In other chapters (see Chapter 4) participants report perceived menstrual cycle differences in mood. Thus it is reasonable to expect that these cycle phase may have influenced how some of the focus group participants responded to the questions and interacted with the other focus group participants.

It seems that for these young females, menstruation continues to be something that is tolerated and remains a negative aspect of womanhood. Indeed, it seems that females themselves keep the focus of discussions on the negative aspects of the menstrual cycles and rather than consider what might be positive they reinforce their belief that menstruation is inconvenient, shameful and disgusting. In hindsight participants could have been asked about where they were in their menstrual cycle as this may have influenced how they responded. It would be interesting to carry out further focus group sessions with participants in different menstrual cycle phases then examine the responses to see if they differed across the menstrual cycle.

Study 2. Male attitudes towards menstruation

2.6 Introduction (Male participants)

Very little research exploring adult male attitude towards menstruation exists and a literature search revealed that research often relates to adolescent boys and how they learn about menstruation (Allen Kaestle & Goldberg, 2011; Chang et al., 2012; Cheng, Yang & Liou, 2007; Fingerson, 2005). Typically, men have been shown to use more negative terminology when talking about menstruation, regarding it as something that causes moodiness in women or that it in some way debilitates them (Brookes-Gunn & Ruble, 1986). Although men are quick to blame menstruation for moodiness they are also frequently uncomfortable with women who are open about menstruation (Laws, 1990).

Wong et al. (2013) surveyed Chinese undergraduates and found that both females and males held negative beliefs about menstruation with males more than females believing menstruation should be kept hidden. Undergraduates studying non health related subjects were more negative about menstruation than undergraduates studying health related topics. Researchers here used an adapted

version of the Beliefs about and Attitudes toward Menstruation (BATM) Questionnaire (Marván et al., 2006) which measures attitudes on a five point Likert scale so they had no opportunity to ask participants to expand on, or explain, their responses. However, a focus group setting provides an opportunity for open discussion allowing participants to expand on their responses if they so wish.

A basic internet search using Google with the term 'male's thoughts on the menstrual cycle' returned websites with articles and blogs from males telling other males how to interact with, or what to expect from menstruating females. One blog asked males for their thoughts then offered information about what menstruation involves in an attempt to debunk popular myths (Swyftwynd, 2012). One thread called Guys: your thoughts on girls' periods! hosted in the Student Room (C++, 2009) begins with a very negative comment using derogatory language and invites other males to contribute. This is followed by a mixture of responses with some written in equally negative and derogatory terms, while other respondents chastise the initiator for his attitude. The negativity and strong language used is not limited to males, many of the responses are submitted by females. Thornton (2013) examined over 2000 English language tweets referring to menstruation and found that the males who posted tweets used very stereotypical language discussing moody females and the barrier to sex that menstruation causes. Female respondents who posted tweets, however, used similar language and often expressed agreement with the males.

As discussed previously, media often constructs menstruation negatively (Erchull et al., 2002), and this combined with the design of current menstrual products imply that females should keep menstruation hidden (Erchull, 2013; Kama & Barak-Brandes, 2013; Laws, 1990). This feeds into feelings of negativity and may be at the root of why females believe others (including males) would be disgusted if their menses were apparent. Females may be uncomfortable discussing menstruation

with males and it may be that this reluctance prevents males from becoming more knowledgeable about it and perpetuates negativity towards it (Allen et al., 2010).

Male negativity towards the menstrual cycle is reported in research (e.g. Beausang & Razor, 2000; Forbes, Adams-Curtis, White & Holgrem, 2003; Laws, 1990; Roberts, Goldenberg, Power & Pyszynski, 2002), however; this negativity may not be fixed and it might alter over time. Males may initially be negative about menstruation but as they mature and become involved in relationships their attitude tends to change and the manner in which they respond to negativity in others may reflect these changes (Chang, Hayter & Lin, 2012). Attitudes towards menstruation are also influenced by siblings with males who have sisters differing in attitude to males with only same sex siblings. Males with sisters have been found to show a more tolerant attitude towards menstruation than males with only same sex siblings (Allen et al., 2011).

In the female focus group sessions, the word most often used to describe how females' perceived men would feel if they knew a woman was menstruating was disgust. Three types of disgust have been suggested; pathogen disgust, moral disgust and sexual disgust (de Jong, Overeld & Brog, 2013) and each is thought to have evolved for specific reasons. Pathogen disgust is thought to be the mechanism by which people avoid infection. Bodily fluids carry infection so disgust in relation to these might be the means of avoiding the transmission of disease (de Jong et al., 2013; Rozin, Nemeroff & Herowitz, 1995). Moral disgust is thought to have evolved to prevent relationships with partners who do not fit with social norms (Kelly, 2011; Tybur, Lieberman& Griskevicius, 2009) and sexual disgust is thought to have evolved to prevent sexual relationships between people such as family members or with animals (de Jong *et al.,* 2013). It may be that pathogen disgust is at the root of the disgust expressed by females in the focus group sessions.

Disgust and negativity dominated the conversations of females in the focus groups and concealing menses from others was a priority. The other factors discussed were often male related and several females expressed the belief that 'others' would be disgusted by a menstruating woman. To explore whether this belief is supported or a misconception on the part of some females, male participants were recruited to explore their attitude towards menstruation.

2.7 Method

Participants: Eleven males recruited from Abertay University and from friends and family of the male facilitator took part in a total of five small focus group sessions while 45 males answered the same questions presented in questionnaire format. The age of the males taking part ranged from 18 to 36 years.

Materials: For focus group sessions questions used in the female focus group sessions were modified for the males (see Appendix 2.2) but the order of questions remained the same. For example, both groups were asked about positive aspects of the menstrual cycle, females in reference to their own cycle (What aspects of your menstrual cycle can you think of that are positive?); while males were asked in more general terms (Can you think of any aspects of the menstrual cycle that you would regard as positive?). Sessions were carried out in the same quiet lab as the female sessions with refreshments provided and seating arranged in such a way that an informal setting was created. The focus group questions were adapted slightly to allow for them to be presented in questionnaire format (see Appendix 2.2). To maintain anonymity, male focus group participant names were altered to pseudonyms following transcription while for those completing the online questionnaire, only age was requested. Of the 17 questions participants were asked to answer, the three questions of key interest were, "Many women believe men view menstruation in a negative way. Why do you think that is the

case?"; "Many women describe menstruation as disgusting. Do you agree with this?"; "Some women believe that men are disgusted by a menstruating woman. Do you think this is true?"

Procedure: In order to conduct all-male focus groups a male facilitator was required and this was accomplished through Abertay University's psychology summer research volunteer scheme. It was felt that participants would feel more comfortable with a male rather than a female facilitator and therefore would be more candid in their conversations. Additionally, this would be consistent with how the all-female focus groups were conducted. Under the scheme students are asked to apply to work with staff on research projects in their areas of interest over the summer vacation period. The positions are unpaid but provide students with experience of hands on research and provide training for a number of research skills. The male facilitator was a mature student known to the researcher and following instruction on how to recruit participants for this type of research, and how to facilitate sessions, he recruited and conducted the first focus group.

In the female sessions several participants had discussed their perception of male negativity towards menstruation and some mentioned their belief that males are disgusted by menstruating females. To address this, two additional questions were asked, the first stated that some females believe males are negative about menstruation then asked if participants agreed with the statement. The second question stated that 'some women believe that men are disgusted by a menstruating woman' then asked if participants agreed with this.

2.8 Analysis and Discussion

Focus group conversations were transcribed verbatim with respondents identified by their initials and once transcriptions were complete respondents' initials were replaced with pseudonyms.

Transcriptions were examined using the same procedure that had been employed with female participants (See section 2.2) with narratives closely read without note taking to allow the researcher to get a feel of male experiences. A thematic analysis was then carried out to identify the emerging themes and to examine any further themes. Four main themes were identified; 'Sticking to stereotype, 'Inability to empathise, 'Sexual organs should not bleed' and 'Other men are disgusted'.

Table 2.2

Themes and subthemes generated from male responses

Theme Name	Sub themes
Sticking to stereotype	Moody women Barrier to sex
Inability to empathise	Only women bleed Media is to blame
Sexual organs should not bleed	All bodily fluids are disgusting
Other men are disgusted	Natural process Lack of education

Responses in the early focus group sessions were more stereotypical in nature than questionnaire responses, with very animated and raucous discussions about how moody and irritable females are when they have their period. This was accepted, and somewhat encouraged by others in the session. It may have been that participants were self-conscious or uncomfortable with the topic in the group setting but once a remark about moody females was made others in the session loudly agreed and offered examples of their experiences.

Theme 1: Sticking to Stereotype. Some participants discussed menstruation in a stereotypical manner talking about sex and mood swings and once this had been mentioned other participants joined in and the facilitator struggled to move conversations to another topic.

Sub-theme: Moody Women: As expected when stereotypical comments were made about menstruating females these typically related to mood swings and the perceived barrier to sex (Chang et al., 2012; Cheng et al., 2007). Within the focus group setting this was far more evident than in the questionnaire responses and if one participant mentioned mood or menstruation being a barrier to sex this was met with strong agreement and loud laughter from the others in the session. Negative stereotyping related to the menstrual cycle persists and previous research has found male and female participants asked to describe a premenstrual woman and a menstruating woman used words such as moody, irritable, sensitive, depressed and sad (Marván, Islas, Vela, Chrisler & Warren, 2008). In the current study participants were asked specifically about the menstrual phase yet the responses about moodiness and irritability are more typically assigned to females in the premenstrual phase of their cycle.

> **DAVID** yeah [laughs] you don't get sex [all laugh] why? ... because their negativity breeds…laughs. **ALAN** yeah [laughs] their mood swings… yeah pretty much…avoid at all costs…laughs. **BILL** moods….mood swings are ridiculous…. They snap just for the sake of things… you get the brunt of the arguments [laughter from all in group]… **JOE** you really can't win at that point…it's just simply that they're on [makes circular gesture to left of head with hand] one emotional hormonal craze [laughs]. **STEVE** [laughing] I think it must be difficult…I think…I don't know…do guys ever have that…that stage where they have such huge swings [makes a sweeping movement from right to left with hand]…in just how they're feeling?...

In the male focus groups there was a similar pattern of behaviour to the female focus group sessions. When stereotypical or negative comments were made, this set the tone for the remainder of the session. This type of responding was partly responsible for the decision being taken to adapt the questions to allow them to be completed in questionnaire format. Even when a more sympathetic response had been made in focus group sessions, conversation very quickly reverted to stereotypical comments and laughter.

ROBERT I just think it's because we make fun of it... I think it's like natur... well obviously its natural… but I think guys generally... if we... want to make light of a subject... we'll make fun of it [laughter] you know... so if we... yeah natural... yeah an actual fact of life but... what can you do... you can wallow about it... you can ignore it... or you can make light of it [laughter] maybe that's why... you know light of it that's why usually make fun... you know that's the way to do it. Maybe that's why they view it as negative... Cos… [*in a pathetic voice*] we don't understand their pain [laughter from others]. **GARY** yeah I would agree with that... like we're ... we don't really understand the emotional aspect of it... and we see them like... just... we see them [laughing] through our magical crystal balls [*in a whispered voice that is high pitched*] but we do not understand.

Stereotypical responses were also evident in questionnaire responses but this was found to a much lesser extent. Additionally, without vocal encouragement from others, the questionnaire responses tended to be short and to the point with several using exclamation marks as emphasis.

'The mood swings'

'The mood swings! The anger! The frustration!'

'Mood swings, moaning, being an idiot, lack of logic'

'They [males] can't have sex and their girlfriend is more emotive'

'Yes [be] cause usually it means no. sex tonight, moody females and not a happy time'

'Girls more sensitive, can't have sex for a week, a bit gross'

In the female focus groups, participants had been asked to discuss what they felt were the positive aspects of menstruation and many found this difficult to do. When female respondents did comment on positive aspects these were related to reproductive health or relief at not being pregnant. This is a

relatively common response for females to give (e.g. Burrows & Johnson, 2005) and it was not unexpected to find males responding in a similar manner. Male respondents answered in this way more often than female respondents did. Of all of these answers however only one responded in a very stereotypical way and for emphasis added an emoticon.

> 'It shows you aren't pregnant?'
>
> 'It shows you aren't pregnant which could be a positive for some people. It lets you know everything is in order'.
>
> '[It] lets you know you're not pregnant
>
> 'Not being pregnant'
>
> 'It proves that you are not pregnant'
>
> 'Indicator you are not pregnant'
>
> 'You know she's not pregnant!!! :D'

Participants were also asked to consider why females believe males are negative about menstruation. This question had not been asked in the first three focus groups but was included in the remaining two and in the questionnaire format. This was based on some female responses where some had recounted negative experiences with males in relation to menstruation. It was felt that the questions in their current format were not clearly addressing this so this more direct question was added. Little research has been carried out examining adult male's attitudes towards menstruation, however, evidence suggests that some males regard menstruating females negatively (Laws, 1990). More recently Reberte, de Andrade, Hoga, Rudge and Rodolpho, (2014) asked male partners of females diagnosed with PMS about their attitude towards their partner. They found males were uncertain about the distress their partners experienced and could not understand why PMS should cause such changes in them. The authors propose this is caused by a lack of knowledge about what PMS is and

it is this lack of knowledge that leads males to focus on the negative and consider some of the symptoms and mood changes as imaginary.

Male focus group participants were asked to consider why females believe that men in general are negative about the menstrual cycle. Responses here were again much longer than the responses given by questionnaire respondents, but most notable was the length of pause prior to answering. This may be an indication that they had never considered that females perceived them to be negative or simply that they were surprised to be asked such a question.

> **JAMES** [very long pause] ...I don't know...cos we...we sometimes have these discussions...my wife and I...you know especially when she or some of her friends...have erm... really strong pains and erm can't really do move or do much or don't feel up to doing much really...erm you know sometimes you can think that they're ...sick... you know like taking a hot water bottle and erm and sort of cramping up on the couch and erm not really feeling up to anything...but...in the discussions I keep always saying you know actually if you think if you wouldn't experience these things then you would be sick whereas experiencing a period is actually a very healthy sign showing that everything is working alright [agreement from others in the group] and I think with that sort of ...view on it ... or viewpoint or that I'm not really seeing it as something negative rather just as something that is just ...you know part of it all and actually an indication that ...erm yeah... that everything is healthy and in ...functioning...as it should...so the reason why women perceive guys to see it negatively is because...

Although James was initially understanding and supportive of his wife's experiences he did again comment on his wife's mood and how he coped with her changed emotions. This is similar to previous research that reports that males tend to focus on the negative symptoms generally reported by females in the premenstrual phase (Laws, 1990; Reberte et al., 2014)

> ‘I don’t know...as I said earlier... I can’t really get used to the fact of being snapped at [laughter from group] and I might not always respond the way I should or be as... I don’t know professional or not take it too personally or not being able to empathise to the extent that would help with it and so my reaction is not really helping it’.

Negativity towards the menstrual cycle was in some cases blamed on the way in which females discuss menstruation and this suggests that when females talk to males about menstruation they do so by complaining. Females also focus on pain or menstrual cramps when discussing menstruation with other females and this may enforce the negative menstrual experiences (Choi & McKeown, 1997; Johnston-Robledo & Chrisler, 2011; Kama & Barak-Brandes, 2013; Oxley, 1998). This was evident in the female focus groups when participants were asked what they felt were negative aspects of the menstrual cycle and some simply listed symptoms such as spots and cramps. Responses given by some males indicate that this type of complaining persists when females talk to males about menstruation.

> **IAN**: I feel...that I try to be as sympathetic as possible... I think most of the stuff you hear about it from women as well is the negative side of things so I wouldn't say... I wouldn't have had your same point of view that... this is a positive thing...I've never thought of it as that...that this is a positive sign that...erm...although I know that in a sense for many people it is a very positive sign [laughing]...cos it means they're not pregnant [laughter and agreement from group] so...[laughing] it’s really a joyous occasion...yeah I'm... I could say that a lot of it's never been sympathetic...or women perceiving men to be unsympathetic...

Robert states that making fun of menstruation is simply his coping mechanism suggesting any stereotypical comments are merely a means to avoid an uncomfortable conversation and this offers a plausible explanation as to why males may perceived as being negative.

ROBERT you can ignore it... or you can make light of it [laughter] maybe that's why... you know light of it that's why usually make fun... you know that's the way to do it. Maybe that's why they view it as negative...

Questionnaire responses to this question also referred to making fun as being the way to cope or the reason females perceived males as being negative.

***Theme 2: Inability to empathise*.** One of the most common comments made by males in both the focus groups and questionnaire responses was that it was difficult to empathise with females as males cannot experience menstruation personally. They also blamed the media for the manner in which they portrayed menstruation.

Some of the respondents considered their own lack of knowledge or their inability to empathise as reasons for females perceiving them to be negative. This is similar to Allen et al. (2011) who found several high school boys expressed relief that they did not experience menstruation and acknowledged that menstruation was not something they would personally like to experience. Several of the questionnaire respondents echoed this sentiment.

'I think this is because men don't have to go through a menstruation cycle, which means men don't appreciate the pain which women go through with their menstruation cycle. This is why I believe women think men view it negatively.'

'Because we don't have anything to compare it to, and it comes with mood swings.'

'Because it does not happen to them. They have no ground to empathise with a woman's position'

Other respondents were less understanding and made it clear why they had negative views firstly that males simply do not want to know about menstruation '[Be] cause men don't really want to know about it or understand' then blaming females for causing males to be negative. Attitudes towards menstruation and negative stereotyping about menstruating females can cause negative attitudes towards females and this respondent seems to blame female behaviour for his negative view of menstruation. This was not, however, a common response.

> 'Because it's true, if they [women] weren't so moody and stupid it wouldn't be an unpleasant thing to deal with'.

Some younger males state that avoiding the topic of menstruation is deliberate because they do not want to discuss it or believe it is a topic that should not be discussed (Chang et al., 2012) while some older males may not regard menstruation as an important topic and are more concerned with how to interact with a menstruating woman (Cheng et al., 2007). Some of the responses support the idea that because males don't experience menstruation they feel they have no obligation to try and understand how the female might feel or what she is experiencing (Allen et al., 2011).

Allen et al. (2011) categorise males in three ways when discussing attitudes to menstruation. Males who continue to find menstruation disgusting; males who believe they are learning to be mature about menstruation; and those who feel they have matured because of an intimate relationship with a woman. Some of responses given in this study seem to fit with these categories and it may be that age was a factor here. Many of the participants in this study were first year undergraduates aged between 18 and 19 (completing the questionnaire for course credit) and it is possible that some have little experience of relationships. The age range of males who took part in the focus group sessions was more diverse with some of the participants being older, married or in long term relationships.

Theme 3: Sexual Organs Should Not Bleed. One of the most striking things to emerge from the data was the high number of males who seemed disturbed by the association between blood and female genitals. For some this was simply a dislike of blood but for others the location of the blood was the issue.

Female participants were concerned about concealment of menses and the effort required in keeping it hidden, and this is widely reported in previous research (Burrows & Johnson, 2005; Erchull et al., 2002; Johnston-Robledo & Chrisler, 2011; Kama & Barak-Brandes, 2013). Males were more visceral and concerned about the connection between blood and genitals believing that this connection might somehow be at the root of female negativity.

> 'Because of the blood I imagine'
>
> 'The association between blood and genitals'.
>
> 'It's slimy, bloody and has to do with genitals, naturally people may be embarrassed'.

Attitudes towards menstrual sex have been shown to be influenced by relationship status with females in committed relationships more likely to engage in menstrual sex than females not in committed relationships (Allen & Goldberg, 2009). Some males have expressed disgust in relation to menstrual sex with some describing this as 'nasty' or 'gross' and this can lead to them being critical of females who engage in it (Allen & Goldberg, 2009). With this in mind none of the questions included in the focus group sessions or the questionnaire related to menstrual sex, however, some participants did refer to it in their responses, particularly when the questions related to disgust.

> 'No. It's a natural thing and shouldn't be a problem, especially within a relationship. Even sex is possible, if it is just a little bloody'.

It may be that those who refer to menstruation as natural and do not regard it as a barrier to sex are in committed relationships (Allen & Goldberg, 2009). Although focus group sessions did not focus on relationships it would have been useful to record relationship status since this may have influenced attitudes.

Males were asked directly why they thought females find menstruation disgusting. When this question was asked in the focus group setting there was a long pause prior to answering. Some males were surprised to hear that females had said menstruation was disgusting and seemed to struggle to understand why it might be disgusting.

> **JAMES**: [long pause]...no... I haven't... I haven't met women that aren't discrete about it...so I can't really say that I ever encountered anything that could be disgusting but I don't think it is.
>
> **IAN**: [long pause] I... I don't know [very long pause] I... I'm...I feel like I'm very squeamish about a lot of things in life...and so... the fine details of ...of the [laughs] you know what's involved in a period [agreement from group]...in all... yeah...these...these are the kind of things I probably would be slightly repulsed by...but that's applicable to so many things [agreement from group] ...it's not [laughs] anything special in that front.
>
> **Robert.** No... I think it's just normal... it's a bodily fluid... it's no different than coughing something out of your throat when you've got a cough.

Many of the questionnaire respondents, however, agreed that menstruation was disgusting and stated that they understood why females might find it disgusting. Once again some were concerned about the connection between blood and genitals.

> 'Yes, it isn't an enjoyable part of being a woman. As a guy the concept of blood coming out of my genitals is enough to make me gag so I can't imagine what it is like for a woman'

'[I] would rather describe it as troublesome or annoying as I do not feel any disgust towards blood but I can understand the feeling when it gets in your vagina, underwear and so…'

'Partly. Even if this is natural I find it a bit gross, I mean its blood coming out of the vagina'

Those who disagreed stated that menstruation is natural and is something that should be accepted.

'No, I'm sure it's very inconvenient but it's a normal, healthy way of life for females' 'Menstruation is a perfectly natural biological mechanism and should not be viewed as disgusting. Why women would think or describe this as such is beyond me'.

It is interesting to note that males used the word natural in relation the menstrual cycle far more than females did. In the female focus group sessions only one participant used this term to describe menstruation while 22 individual males used the word natural in their questionnaire responses when describing menstruation.

Asking males about menstruation was largely driven by comments made by some of the females in the earlier focus group sessions. When discussions related to concealment of menstruation some females were concerned what others would think about them had their menses been evident. For many of the females the 'others' that were being discussed were male and several named boyfriends, male friends or family members when discussing concealment. Recruitment of males was intended to address this and to discover if males are disgusted by menstruating females, or if this is a misconception on the part of those females. Males were asked an additional question ('some women believe that men are disgusted by a menstruating woman. Do you think this is true?), and this was direct in nature to avoid any misunderstanding. When this question had been asked in focus groups those being asked paused for far longer than they had before answering any other question. Two respondents asked for the question to be repeated and their tone indicated they were unsure they had heard the question correctly.

JAMES: sorry can you repeat that? [**FACILITATOR** repeats] **JAMES** disgusted by the actual menstruation...or by the female who is menstruating? [**FACILITATOR** clarifies] **JAMES**: [very long pause] well...I don't know...might be that some men are... the ones that I know including myself... I cannot imagine that anyone would be disgusted by the female...strange... I never... I think...not being really sympathetic that is one thing, but being disgusted would be another thing... **IAN**:... being disgusted at the female... you know this isn't like... some other...yeah... I mean it's something that basically happens to all women...very regularly...it's not like you know... being disgusted at someone for… you know...soiling themselves in other ways [laughter from group] **JAMES**: yeah it's almost like being disgusted by women in general... don't... don't see that. **IAN**: yeah... type of man who... has other issues

ROBERT sorry can you repeat the question? [**FACILITATOR** repeats] [very long pause] personally no. **GARY** [very long pause] no

Responses to the questionnaire revealed a distinct pattern to how males responded. For those who agreed menstruating females were disgusting the response was either a personal one or the respondent claimed that they (*or their friends*) were not disgusted but *others* were. Those who disagreed that males are disgusted by menstruating females framed their answers in terms of menstruation being a natural process.

'Not disgusted as such, but definitely has a negative connotation'

'No as again it is a part of life'

'Again women believe many things which are not true. In my experience men are not disgusted by a menstruating woman. I therefore have no idea why some women would think this?'

'I don't know if that's true but I don't feel disgusted by a menstruating woman'

During one of the focus groups one participant's response suggests that he has become more comfortable with menstruation and this seems to fit with the argument that attitudes do change as males mature and enter into relationships with females (Allen et al., 2011)

> **GARY** yeah it's weird to start ... you just get used to it...

Following this response the facilitator asked the group how they would feel had they found a bloody tissue in a toilet. This led to one participant describing a personal experience intended to demonstrate his acceptance of this normal occurrence, however, others in the group reacted with disgust.

> **Robert**... I'll give you an example actually. [Laughter from others] nah...nah I'll give you an example right?. In our flat right... we have communal toilets right [agreement from others] and 3 weeks ago... I think it was 3 weeks ago... I went in to use the bathroom and there was blood on the seat right [***others make loud sounds of disgust and hold hands up to their mouths***] …and on the bowl right...if... I was just like... 'fucks sake' [laughter from others]... you could at least clean... right? [Agreement from others] but it was like you know right... you see it.

The respondent himself seems to have taken issue here not with the blood but rather is irritated that the female had not cleaned the toilet. It is unclear, however, if the disgust expressed by the others in the session is related to the blood itself or the lack of cleanliness. Either way this spontaneous reaction was a clear expression of disgust.

Many of the respondents simply stated yes or no to this question, however, those who offered more than a single word response to the answer related this to mood and the perceived barrier to sex. These responses were made not only in terms of the individuals but related to their friends too.

> 'No never heard any friends or that say they are'

> 'No not nowadays. There is information and men know it's a natural thing. I personally cannot think of a friend of mine who could consider himself disgusted'

> Yes, there are a lot of negative thoughts from men about menstruating women due to the 'blood' and women are seen to be 'moody'.

> 'Yes [be]cause usually it means no. sex tonight, moody females and not a happy time'

In the female focus groups two participants discussed menstrual sex and the negative reactions of their male partners. In both cases their partners had expressed disgust related to the blood but would not discuss the matter further. Allen and Goldberg (2009) found that some males were disturbed by blood while others feared menstrual sex might cause the female pain. Male respondents in the current study who expressed disgust tended to relate this to blood and again the connection with the vagina.

> 'Yes, in general, the idea of blood dripping from the vagina sounds rather disgusting. The lack of understanding and familiarity, plus the general disgust towards stuff coming out from genitals makes regular males feel disgusted'

> 'Yes I do, again the idea of blood and pain partnered in the sexual area of the body is not the nicest thought'

> 'I don't like the idea of like a rainbow kiss... or anything like that'

> 'When aroused I do not care. A lot of things lose their disgustingness when aroused'

This last comment seems a very honest response and evidence suggests that disgust diminishes if a person is sexually aroused (Ariely & Lowenstein, 2006; de Jong et al., 2013). Sexual arousal has been shown to influence judgement about risks related to unprotected sex such as sexually transmitted diseases (STD's) or pregnancy (Ariely & Lowenstein, 2006; Ditto, Pizzaro, Epstein, Jacobson & MacDonald, 2005) and this response seems to acknowledge that this might be true for some males.

Females have higher disgust sensitivity than males (Curtis, Aunger & Rabie, 2004; Holstermann, et al., 2012; Rohrmann, Hopp & Quirin, 2008; Skolnick, 2013) and in the female focus group sessions, disgust or disgusting was used to describe menstruation 27 times by 10 different females. Male participants differed in their use of the word with disgust or disgusting only mentioned when the facilitator directly asked about disgust in relation to menstruation. In total, disgust or its derivatives were used 25 times, however, unlike female participants the majority of respondents were stating that they *did not* feel disgust nor did they know of others who would be disgusted. Of the 25 times the word was used, 17 were used to *refute* the idea that menstruation is disgusting.

Theme 4: Other men are disgusted*:* Many of the responses that were given in the focus groups and in the questionnaires concerned friends or 'other men'. Males did this far more than female participants did and while some of the responses related to other men being disgusted, others were more in the defence of 'other males'

Several of the responses indicated that while the male was not personally disgusted his perception was that other males probably are. This is similar to the type of responses given by some females who also perceived that others (often, but not exclusively males) would be disgusted by a menstruating female.

> 'Yes I think this is true but I think this is only the case for a small population of males and I don't completely understand why they feel this way as males and females are human beings at the end of the day regardless of what's happening to their bodies in this case menstruating in woman [sic]';
>
> 'I believe some men may be disgusted by it, but I am personally not one of them'
>
> 'I think that's true but mainly with men that are maybe more sexist and misogynistic; the kind of men that would ask a woman if she is on her period when in a bad mood. For an adolescent

in high school it's pretty normal to have a grossed out reaction because at that age we aren't mature but as an adult now most men should be comfortable with the idea their girlfriend and female pals occasionally bleed out of their vagina'

'Some men probably are, they are likely immature or uneducated however'.

Others were clear to state that none of their friends were disgusted by a menstruating woman although answers to other questions seem to suggest menstruation is not a frequent topic of conversation between males groups. This might also suggest that respondents do not wish to be associated with males who express disgust at menstruation or may simply be evidence that males are providing socially desirable answers.

'Some men are. Not all of my friends though'

'I personally cannot think of a friend of mine who could consider himself disgusted. However I believe that uneducated men still think so. Again education and school is the key'

Some responses related to a woman's health with some respondents regarding regular menstruation as a sign of a healthy body and again this is similar to some of the responses given by female participants. Some of these responses also demonstrate a lack of understanding of the menstrual cycle and again this bears some similarity to responses given in the female focus groups.

'The fact that a woman has a menstrual cycle shows that she is healthy'. 'Yeah, she's healthy'

'It gives the female body a monthly 'clean' and shows the women's reproductive system is a healthy one'.

'It updates your health'.

'Start of possible new life'

These comments highlight gaps in knowledge for some males in relation to the menstrual cycle, but this is also common in young females (Cohn & Richters, 2013; Houston, Abraham, Huang & D' Angelo, 2006; White, 2013) so it is not particularly surprising. Often the information boys receive about the menstrual cycle comes from discussions with other boys and evidence suggests that girls receive more education about matters relating to sexuality than boys do (Allen et al., 2011).

***Comparison of male and female attitudes towards menstruation**:* Females remain negative about the menstrual cycle and this may be due to the social construction of menstruation (Jackson & Flamagne, 2013; Johnston-Robledo & Chrisler, 2011) and perhaps then there should be no surprise that there was also a lot of negativity shown by a number of male respondents. Negativity, however, was not universal and a large proportion of male respondents expressed surprise that females were negative about menstruation. Males in focus group sessions appeared shocked to be asked about disgust about menstruation and the length of time they paused before answering the question emphasised this. This does not fit with previous research which reports males as holding negative and stereotypical attitudes towards menstruation (Chang et al., 2012; Cheng et al., 2007) and may be an indication of changing attitudes amongst males. The tone of some of the written responses seemed to indicate that participants who completed the questionnaire may also have been surprised by the question. Some responses were almost defensive in nature with the media criticised for portraying menstruation negatively. Some males also felt a need to defend their friends clearly stating that to their knowledge none of their friends felt disgust in relation to menstruation or towards menstruating females. There is a possibility that some of these responses were driven by demand characteristics but as the study was anonymous it is not possible to follow up on responses. Perhaps an additional question could be added in future asking participants if they were surprised to be asked if a menstruating female is disgusting then asking them to explain their answer.

One significant area where females feel very concerned, but males did not share this, was the issue of concealing menstruation and what 'others' would think of them, with many believing 'others' would be disgusted (found in aspects of two themes; 'Menstruation as Disgusting' and 'Menstruation as shameful or embarrassing'). Although sometimes concern was related to other females knowing for many of the females the 'others' they were concerned about were male. This was at odds with the male responses regarding their own behaviour and their responses do not reflect this and males were in some cases more positive about menstruation than females. Indeed, males were far more likely than females to describe menstruation as a natural process. Females reported that the males they did discuss menstruation with (boyfriends, fathers or brothers) were uncomfortable and tended to respond in a stereotypical manner with responses limited to mood swings and cramps and this is similar to previous findings (Brookes-Gunn & Ruble, 1986; Laws, 1992). This again seems to indicate that when males and females converse about menstruation both sexes talk predominantly in negative terms. Females will complain of pain or cramps and males seem to respond to this negativity by being negative in return perhaps as a defence against a topic they find uncomfortable. Adverts for products such as directed pain killers (e.g. Feminax Express®, Bayer HealthCare AG, 2012) and heat pads to relieve menstrual cramps or pain imply that menstruation is unpleasant and something requiring specialised treatment (Burrows & Johnson, 2005). US products such as Cetamol Menstrual® (Federated Pharmaceutical, 2012) follow the same format listing the symptoms experienced (menstrual cramp, headache, backache, fatigue and bloating) and claim relief for all symptoms which allows the menstruating woman to "get back to you". This type of advertising is highly suggestive and delivers a message to both females and males that menstruation is painful, debilitating and personality changing. Females tend to complain about these negative aspects to other females and to males perpetuating the notion that menstrual experiences are largely negative for all females (Choi & McKeown, 1997; Oxley, 1998).

Feminine hygiene products are designed to make menstruation undetectable and advertisements are constructed in such a way to imply females can only behave normally if their menses are completely concealed (Erchull, 2013). Such advertising plays on feelings of shame and embarrassment reported by many females. Koutroulis (2001, p203) notes that "a sperm or smegma shield designed especially for men to absorb 'that little problem' of their genital secretions, or an under foreskin spray deodorant to prepare him for all possible occasions" has yet to be developed and marketed, yet for females, intimate deodorisers and scented panty liners are a requirement for females wishing to keep their menses hidden and any perceived smell masked. In the case of the latest UK "Always" advertisement, their latest product (Always Ultra ActiPearls™) does not simply mask the odour of menstrual blood, it "neutralises" it so that females can have a "happy period" (www.always-info.co.uk). There is currently no USA equivalent to ActiPearls™; however, the latest in the USA Always range (Always Radiant Infinity™) has a "light, clean scent to help you feel fresh" (Proctor & Gamble, 2014). The stressing of a product's ability to deal with menstrual blood seems to be shrewd on the part of advertisers given the way females in the focus group sessions talked about their menstrual blood, stressing how it differs from venous blood.

Many of the male respondents blamed their negative attitudes on the media and how it portrays menstruation. Situation comedies such as Big Bang Theory (Lorre et al., 2007 – 2015) often explain negative behaviour in female characters as being caused by her menstrual cycle but this type of negative stereotyping is not limited to television and film. A simple internet search using the phrase "jokes about women's periods" entered into a search engine (www.google.co.uk) identified more than nine million websites containing jokes and comic pictures related to menstruation with many depicting females as out of control or murderous. When asked what is positive about menstruation responses from both genders were framed around fertility. Eight individual male respondents commented that menstruation is a welcome sign that pregnancy has not occurred while four female respondents

responded in a similar manner. This type of response is typical in females (Burrows & Johnson, 2005) so it should not be surprising that males too respond in a similar manner.

Evidence suggests that family members such as siblings can influence attitudes towards the menstrual cycle (Allen et al., 2011) and this should be examined in future studies. Additionally, participants can be asked how they learned about menstruation. It would be interesting to look at those males who learned from parents, for example, a mother's response to her daughter at menarche has been shown to impact how her daughter feels about her own menstrual cycle (Marvan & Molina-Abolnik, 2012; Ozdemir et al., 2010). To my knowledge, no research exists that considers parental attitude on male responses to learning about menstruation. It seems reasonable to assume that a parent who has a positive view of menstruation might approach such a discussion differently to a parent who holds a negative view. Questions relating to this can be included in any future questionnaire or focus group session. In addition to this, the family dynamic is changing with many families having single or same sex parents. Future research should be carried out with such families to discover how these parents educate adolescents about menstruation; although recruiting large samples of same sex parents may be challenging.

2.9 Limitations

Focus groups were an excellent method for exploring attitudes towards menstruation, however, the difficulty in recruiting males to take part in such discussions meant that alternative methods had to be employed. Creating the open-ended questionnaire allowed for multiple detailed responses but some participants did not always give lengthy answers and further questionnaires may include additional questions to encourage longer responses. Additional demographic information could be sought from

participants giving insight into family dynamics which might influence attitudes. At this time the recruitment of females to complete a similar questionnaire has begun and so far 55 participants have taken part. The intention is to examine these responses and to compare them with responses from focus group participants and male questionnaire respondents.

Males' attitudes towards the menstrual cycle varied with some expressing disgust while others argued menstruation is natural and therefore should not be considered as disgusting. It might be useful in future studies to include a measure of disgust (e.g. Haidt et al., 1994). Participants who are high in disgust sensitivity may respond to questions differently than those who are low in disgust sensitivity. The clearest evidence of disgust towards menstrual blood was witnessed in the reaction of male respondents when one mentioned finding menstrual blood on a toilet seat. His annoyance here had been a lack of cleanliness, yet the reaction of the others in the session was a clear expression of disgust. It is not unreasonable to expect that many females would have a similar reaction to finding menstrual blood on a toilet seat. When the facilitator in the female sessions described a personal experience where a girl had unexpectedly started her first period and blood was visible on her clothing, the others in the groups responded with sympathy rather than disgust and again it is reasonable to expect that males would have a similar response to this account. In a future study both scenarios could be described and reactions of male and female participants compared.

Menstrual cycle research continues to report mainly negative aspects such as suicide (e.g. Baca-Garcia et al., 2010; Cunningham, Yonkers, O'Brien & Eriksson, 2009) and mood swings (e.g. Natale & Alberatazzi, 2006) and although some research investigating more positive aspects has been carried out (e.g. Chrisler, Johnston, Champagne & Preston, 1994; Hampson, 1990; McPherson & Korfine, 2004), negative attitudes prevail. For some females menstruation continues to be something to be tolerated and regarded as a negative aspect of womanhood. This is consistent with recent research

suggesting that for many females, menstruation is something to be tolerated (Jackson & Falmange, 2013). Males also express negative attitudes towards menstruation and these negative attitudes are openly expressed and often supported by other males *and* females using social media (Thornton, 2013). Approaching menstruation with a positive attitude as a researcher may not evoke positivity about menstruation in females. Indeed it seems that females themselves keep the focus of discussions on the negative aspects of the menstrual cycles. Rather than consider what might be positive, they reinforce their belief that menstruation is inconvenient, embarrassing and disgusting.

During some of the sessions females discussed contraception and eleven of the females discussed their choices for birth control and their preference for contraceptive injections or hormonal implants. For these females menstruation is rare and all of the females who expressed a preference liked the fact that they did not experience menstruation. These females said they felt in control of their bodies and were happy not to menstruate; indeed, for some the lack of menses was treated as a bonus. Coutinho and Segal (1999) suggest menstruation is an inconvenience that females no longer have to tolerate and for some of these young females this seems the accepted view. This change in attitude is becoming more apparent with evidence suggesting that females want to alter the frequency of menstruation or indeed stating that they would prefer not to menstruate (Aubney, 2007; Lakehomer et al., 2013). Glasier et al. (2003) found that 65% of the Scottish females included in their sample would choose to use a method of contraception that would stop their period.

Males, although perceived by some females to be negative about the menstrual cycle, were far more likely to describe menstruation as natural and appeared to be shocked to discover that some females held such a perception of them. It seems that for some females and males menstruation continues to be perceived as mainly negative, however, both sexes also suggested positive aspects of menstruation and although this was often limited to reproductive health this may be attributed to the

age of the participants. These were mainly young adults and it may be that they plan to have children in the future so it seems appropriate that good reproductive health is regarded as a positive aspect of menstruation.

Study 2 aimed to investigate male participants' attitudes towards menstruation and more specifically to investigate the perception expressed by some female respondents, that males are disgusted by menstruating females. Responses were mixed with some males expressing disgust while others (many more than female respondents) described menstruation as a natural process and therefore not disgusting. Males appeared surprised to be asked the question which implies they had never considered this previously. This merits further investigation and a focus group setting, or a one to one interview would allow responses to be followed up. Questions about how males learn about menstruation and who initially tells them about it might provide insight into current attitudes. A high proportion of respondents stated that their knowledge came from school and that often they were separated from females for this information. If education is limited and knowledge about the menstrual cycle is gained through joking with male friends about moody and irritable females it seems logical that a mainly negative attitude may develop. Information about siblings and other family dynamics such as parental status or birth order should be included to allow for comparison of attitudes. It is possible that males with female siblings might be more tolerant or more educated than males with only male siblings. It would also be useful to examine the attitudes of males who grew up in single parent families with or without female siblings.

2.10 Conclusion

It seems that for some, menstruation continues to be something that is tolerated and remains a negative aspect of womanhood. Focus groups conversations, often focused on negatives which is

consistent with recent research suggesting menstruation is something to be tolerated (Jackson & Falmange, 2013) and that many females and males continue to hold negative stereotypical views of menstruation (Thornton, 2013). Indeed, females themselves keep the focus of discussions on the negative aspects of the menstrual cycles and when conversing with males about menstruation, they keep the conversation negative. Rather than consider what might be positive this simply reinforces the belief that menstruation is inconvenient, embarrassing and disgusting.

In this chapter participants' attitudes towards the menstrual cycle were examined allowing an indirect assessment of perceived changes in mood and personality that have previously been reported by females (e.g. Baca-Garcia et al., 2010; Natale & Alberatazzi, 2006; Sassoon et al.,2011). Some female participants attributed negative attitudes towards their menstrual cycles to sex hormones. There is evidence to suggest that sex hormones do influence mood with links shown between estrogen and positive mood (e.g. Farage et al., 2008; Shors & Leuner, 2003) and progesterone and negative mood (e.g. Eriksson et al., 1992; Halbreich, Endicott, Goldstein & Nee, 1986). Conversations amongst female participants would seem to indicate that females do perceive that these changes in mood are linked to their menstrual cycle. Chapter 4 will examine these changes experimentally to find out if these perceived changes can be measured.

Chapter 3: Charting the Menstrual Cycle

3.0 Overview

The aim of this thesis is to examine the influence of menstrual phase on specific psychological functions, using a three phase approach, with a particular focus on possible influences of progesterone (See Chapter 1). If this is to be achieved, then correctly estimating when progesterone peaks and estrogen levels are reduced is vital. Accurate measurement of cycle phase is important as any identified change in performance should be clearly linked to menstrual cycle phase shifts. For this reason, various methods previously employed by researchers in order to chart the menstrual cycle will be considered. Once these methods have been evaluated a decision will be made about which testing protocol is appropriate for identifying testing phases for experimental work (Chapter 4).

3.1 Decisions Related to Participants

In addition to deciding how and when during the menstrual cycle to test, deciding how many individuals should be tested is an important issue. Chapter 2 clearly outlined that there is a general negativity related to the menstrual cycle and a reluctance to take part in research related to it. While the qualitative exploration in that chapter gave an excellent contextual background for the experimental work, it is clear that recruitment of females for menstrual cycle research is challenging (see McAra & Wright, 2011). Consequently it should be no surprise that many studies are carried out with very small samples (i.e. typically 12 or less, see Table 3.1 for some examples). Using small samples is certainly the norm when invasive techniques of menstrual cycle measurement (blood, or urine samples) are employed. However, this is not unique to these methodologies, as studies using less invasive techniques (e.g. Celec et al., 2011; Garrett & Elder., 1984; Šimić & Santini, 2012) have also been

carried out with small samples (Table 3.1). Typically, repeated testing of participants can be affected by high attrition rates and it may be that this leads to smaller samples in this type of research. A systematic search of the literature was carried out between 03/06/2014 and 16/06/2016 to determine what research has been reported relating to menstrual cycle phase effects on positive and negative mood (see Chapter 1 Section 1.4.5). As this area is central to the current thesis (explored in Chapter 4), articles returned in these searches that were deemed relevant to the current exploration of the methodology were used to determine how cycle phases were identified and demonstrate that many were carried out with small samples.

Table 3.1

A selection of studies illustrating the small samples typically used in menstrual cycle research.

Authors	Sample size	Method
Celec, et al. (2011)	10	Count method
Brambilla, Speca, Pacchiarotti & Biondi (2010)	15	Blood samples
Courvoisier et al. (2013)	17 (7 female)	Saliva samples
Garrett & Elder (1984)	8	Self-report & count
Hausmann et al. (2000)	12	Blood samples
Schoning et al. (2007)	24 (12 female)	Blood samples
Šimić & Santini (2012)	17	Count method
Solis-Ortiz & Cabrera (2008)	9	EEG activity & Body basal temperature

Table 3.1 shows a selection of studies carried out with small samples of participants. This is in no way exhaustive but is illustrative in terms of exemplars showing different methods of charting the menstrual cycle which have been carried out with small samples. This neatly demonstrates that while very small samples are often used in research where multiple and/or invasive measures are taken, it is also the case that small samples are frequently used when simple and non-invasive methods are employed. Small samples however are problematic and it is difficult to make generalisations based on results

from small samples. Recruitment to the studies carried out in this thesis was difficult and retaining participants proved difficult. It must be acknowledged that this may well have influenced the results and it may be that some effects were diminished by the attrition rate.

Individual menstrual cycles can differ from cycle to cycle (Mihm et al., 2011; Waller et al., 1998) so drawing conclusions based on such small numbers may be unwise. However, when hormonal assays are used, samples tend to be smaller. Large sample studies based on pre-existing data sets (Females' Health Initiative (WHI) & Females' Health Initiative Memory study (WHIMS)) can identify trends and lead to new research questions (Resnick et al., 2006). However, while useful, pre-existing data sets limit and determine what the researcher can examine. WHI and WHIMS examined the effects of combination oestrogen and progesterone replacement on cognition and affect in 1416 women. Such studies provide evidence of the influence of hormones on some cognitive skills with for example, superior verbal skills shown in females using HRT compared to those not using HRT (Duff & Hampson, 2000). This suggests that sex hormones can influence behaviour and mood. The current research examines potential changes across the menstrual cycle and requires participants to complete a series of tasks or questionnaires in three menstrual cycle phases. It is acknowledged that participant recruitment in this research field can be challenging, however, as Table 3.1 shows there is evidence that this type of research can be conducted with a relatively small sample size. Caution should be taken, however, in how results are interpreted, particularly where attrition rates are high.

***Participant Selection*:** Deciding who to test can also be contentious and previous research has recruited heavily from student populations (Keisner & Pastore, 2010; Roder, Brewer & Fink, 2009), frequently offering incentives to students to get them to take part (Burton, Hafetz & Henninger, 2005; Halari et al., 2005; Lokken & Ferraro, 2006; Oinonen, 2008; van Anders & Hampson, 2005). The aim within this thesis is to predominantly recruit from within the student population, although it is clearly

understood that this is a practice that may be open to criticism (Henrich, Heine & Norenzayan, 2010; Medin & Atran, 2004; Wintre, North & Sugar, 2001). However, it could equally be argued that this population is an ideal pool from which to draw a sample for menstrual cycle research. The logic is that following menarche, girls often experience irregular menstrual cycles but once they have reached their late teens most experience regular menstrual cycles (Mihm et al., 2011). This means that recruiting from within a university population focusses on a large group of young females with enough physiological maturity to have potentially stable cycles. The main focus for the target population in this thesis is to keep participant attrition to a minimum, and to recruit females who have natural cycles.

3.2 Methods for Charting the Cycle

Methodologies for charting the menstrual cycle are varied in terms of cost, complexity and accuracy. Close reading of relevant articles already identified for the thesis (see Chapter 1) demonstrated a wide range of methods that have been employed. These range from the simple calendar methods (e.g. Brown, Calibuso & Roedl, 2011; Garrett & Elder, 1984; Wideman et al., 2013), which involve counting the days between menstruations and using the information to predict when each phase occurs, to more complex and expensive measures such as hormonal assays (Cherrier et al., 2002; Compton et al., 2008; Derntl, 2008; Halpern & Tan, 2001; Hampson et al., 2014) which measure hormonal peaks and nadirs over the course of a cycle. Some research makes use of a single method of measurement (i.e. forward count) (e.g. Little & Jones, 2012), although some research combines methods (i.e. forward count & body basal temperature) (e.g. Frank-Herrmann et al., 2007; Porucznik, Cox, Schliep & Stanford, 2014), to provide more accurate pinpointing of menstrual cycle phases. The number of menstrual cycle phases identified by researchers and specific days within each phase, can differ widely between methods and this can be confusing. For example, the luteal phase (following ovulation until menstruation) can be referred to as the early luteal mid-luteal, or late luteal phase when testing is

carried out on day 21 or 22. In the Average Menstrual Cycle (AMC see Chapter 1 fig 1.2) these days are when progesterone normally peaks, but (as previously discussed in Chapter 1 Section 1.2) not all menstrual cycles are average in length. As one of the current thesis aims is to take a three phase approach, and especially to make sure that the mid-luteal testing captures the progesterone peak, it is clear that menstrual cycle length becomes a factor, as the progesterone surge is largely dependent on when ovulation takes place (Ecochard & Gougeon, 2000).

3.3 Number of testing Sessions

***Single Testing Sessions*:** The number of testing sessions also depends on the researcher's aims with some testing carried out in a single phase such as in the menstrual phase (Halari et al., 2005; Kask et al., 2008), preovulatory phase (Halpern & Tan, 2001; Lokken & Ferraro, 2006), ovulatory phase (Fehring, 2002; Gandara, Leresche, & Mancl, 2007; Katz, Slade & Nakajima, 1997; Miller & Soules, 1996) or the premenstrual phase (Baca-Garcia et al., 2010; Lustyk et al., 2011; Soyda Akyol, Karakaya Arisol & Caykoylu, 2013). Single phase testing generally has a very specific aim such as investigating the effect of attitudes towards menstruation and the relationship to PMS reporting (Lustyk et al., 2011) or pinpointing the precise day of ovulation or the ability of different methods to accurately predict it (Gandara et al., 2007), and so does not offer an appropriate choice for the current research.

***Multiple Testing Sessions*:** Testing over two phases is common and once again the timing of testing is specific to the research theory being utilised. These phases frequently include menstrual and ovulatory phases (e.g. Celec et al., 2011; Kozaki & Yasukouchi, 2009; Schoning et al., 2007) or menstrual and luteal phases (e.g. Epting & Overman 1998; Griksiene & Ruksenas 2011; Hampson & Kimura, 1988; Hampson, Levy-Cooperman & Korman, 2014; Hatta & Nagaya 2009). Most of the two test phase studies tend to involve some measure of performance when hormones are at their lowest

and again when at their highest (i.e. menstruation and ovulation if looking for estrogen effects); or a comparison of behaviour during these phases such as differences in how attractive females find potential mates (e.g. Celec et al., 2011; Hyde & Salk, 2014; Kozaki & Yasukouchi, 2009). In addition, there is variability in the terminology used in order to describe two phase studies with some researchers simply referring to fertile and non-fertile phases (Oinonen & Mazmanian, 2007; Roney & Simmons, 2008) while others specify menstrual and ovulatory phases (Celec et al., 2011).

Table 3.2 Example of multiple test phase studies and their naming system.

Author(s)	Phase Name
Šimić and Santini (2012)	Menstrual, Early follicular, Pre-Ovulation and Mid-luteal
Garrett and Elder (1984)	Menstrual, Ovulation, Post-Ovulation and Premenstrual
Solis-Ortiz and Cabrera (2008)	Menstrual, Ovulation, Early luteal and Late luteal
Pearson and Schipper (2013)	Menstrual, Follicular, Peri-Ovulatory, Luteal and Premenstrual
Stricker et al. (2006)	Early follicular, Late follicular, LH peak, Early luteal, Mid-luteal and Late luteal

Table 3.2 represents a selection of studies that have portioned the menstrual cycle into three or more phases for testing. This is not an exhaustive list but merely a representative sample drawn from articles returned from the systematic searches carried out to identify relevant research for this thesis. For example, researchers seeking to accurately pinpoint ovulation will sometimes extend the phases to include the LH peak thus portioning the cycle in to six phases (e.g. Stricker, et al., 2006). Clearly the most accurate method of measuring the menstrual cycle is to measure hormones daily over the course of a menstrual cycle (e.g. Beynnon & Shultz, 2012; Ecochard & Gougeon, 2000; Santoro et al., 2003; Wideman et al., 2012). However, the methods of achieving this can be very intrusive (Blood and/or urine samples), time consuming and also relatively expensive if measures are taken daily over

28 or more separate occasions. This was not a viable methodology for the present study, due to equipment, participant demands and finances. Participants in the current study were tested three times over the course of the menstrual cycle rather than daily. This was less invasive for participants and more cost effective and allowed for the testing of more women.

***Inconsistencies in Terminology and Phase Division*:** The terminology used by researchers when labelling menstrual cycle phases often differs and this again can lead to confusion. The menstrual cycle is made up of the follicular and luteal phases (see Chapter 1, Section 1.2) and these can also be sub-divided in various different ways (see Table 3.1). The follicular phase is the early part of the cycle from menstruation until the fertile period and the luteal phase makes up the latter half of the cycle.

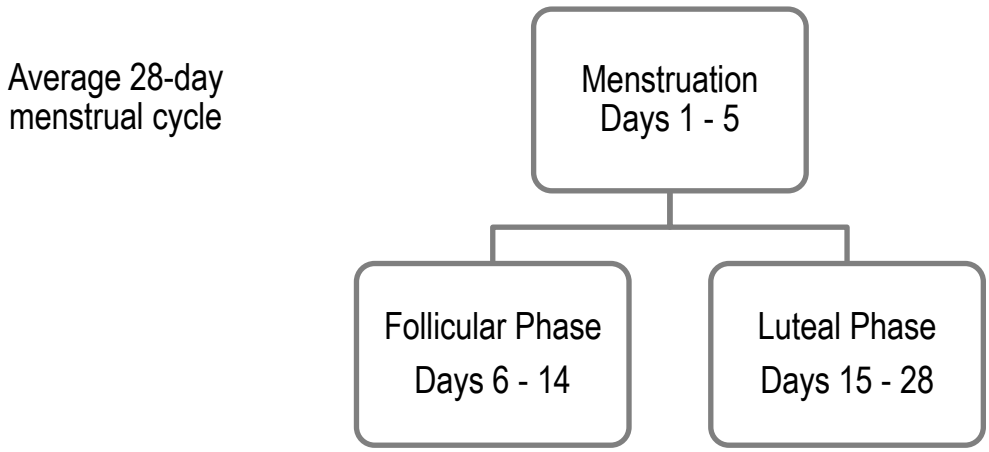


Figure 3.1 Average 28-day menstrual cycle.

A review of the literature shows a lack of consistency in which days researchers consider to make up each phase (see Chapter 1, Section 1.4.5). Most agree on the length of the menstrual phase which is generally considered to occur between days one and five in an average menstrual cycle (e.g. Celec et al., 2011; Hausmann, 2005; Keogh et al., 2014; Wharton et al., 2008) although some research extends this slightly to seven days (Garrett & Elder, 1984; Halari et al., 2005; Simic & Ravlic, 2013). Upon

review, it was clear that the majority of the research carried out in this phase is conducted between days two and five (Epting & Overman, 1998; Griskiene et al., 2011; Hatta & Nagaya, 2009; Mordecai et al., 2008), generally avoiding testing on day one as some females may experience discomfort or pain at the onset of menses. Testing in the ovulatory phase is relatively consistent with most researchers testing on or around day 14, which is considered to be the most likely day of ovulation, particularly if researchers are working to an average 28-day cycle (Celec et al., 2011; Garrett & Elder, 1982; Solis-Ortiz & Cabrera, 2008). Testing at this point will most likely capture the estrogen peak as it is associated with ovulation (see Section 1.4.2 Estrogen).

***Inconsistencies Related to the Luteal Phase*:** Much of the inconsistency amongst researchers relates to the luteal phase with researchers using the terms early luteal, mid-luteal and late luteal but not consistently when testing on the same days as other researchers do within these named phases (Table 3.2). The luteal phase follows ovulation and continues until menstruation (see Chapter 1, Figure 1.2) and during this phase estrogen levels begin to drop while progesterone levels rise to their peak. In the AMC this progesterone peak occurs at day 21 or 22 which is the mid-point of the luteal phase (Mihm et al., 2011). This would suggest that if testing at that time in the menstrual cycle this should be referred to as the mid-luteal phase (see Table 3.3 for example references).

Table 3.3 "Luteal Phase" Test days with differing names applied to the same event.

Author(s)	Phase Name	Day of testing
Solis-Ortiz and Cabrera (2008)	Early Luteal	21 or 22
Epting and Overman (1998); Hausmann (2005); Hatta and Nagaya (2009); Simic, Tokic and Pericic (2010); Simic and Santini (2012)	Mid-luteal	21 or 22
Mordecai et al. (2008); Griskiene et al. (2011)	Luteal	21 or 22

Table 3.3 represents a selection of studies testing on days 21 or 22 who name the phase differently. This list is not exhaustive but instead presents a representative sample drawn from articles returned

from the systematic searches carried out to identify relevant research for this thesis (Chapter 1). Such variability means that researchers must be clear about the days of testing and which phases they regard these days as belonging to. For the purpose of the empirical data in this thesis, testing will be carried out three times across the menstrual cycle and the test phases will be called the menstrual phase, the ovulatory phase and the mid-luteal phase (see **Chapter 1**). Although this clearly sets out the naming system that will be used, the next question to be explored will be the optimal day(s) when testing should be carried out in order to hit each of these three phases. Before settling on this, an investigation into variability in cycles, then 'how to chart' the actual cycle itself will be considered (Chapter 3, Section 3.4). Only after this point will the most appropriate testing days for each phase be determined.

3.4 Cycle Variability - potential source of error

Menstrual cycle length shows both intra and inter female variability (Waller et al., 1998). Menstrual cycle length alters over the course of a woman's fertile years with most variability shown at menarche (onset of menses at puberty) and menopause (cessation of menses). The follicular phase tends to increase as females age whilst the luteal phase decreases (Waller et al., 1998). Different factors also influence variability in the phases of the menstrual cycle; this has been most notable following childbirth or following the use of hormonal contraceptives (Fehring, Schneider & Raviele, 2005). For example, following discontinuation of oral contraceptives, some females have a longer follicular phase and this leads to later than predicted ovulation (Jukic et al., 2007; Nassaralla et al., 2011). Early research using body basal temperature concluded that the follicular phase ranged from 11 to 27 days and the luteal phase ranged from 7 to 15 days (Vollman, 1977). Lenton, Landgren and Sexton (1984) used hormonal assays to record the LH surge and reported a range of 12 to 17 days to be 'normal' for the luteal phase. Following urinary analysis for 403 females over a 60-day period Waller et al (1998) found the follicular

phase to be an average of 16 days and the luteal phase an average of 13 days. Reviewing research findings suggests that most of the variability in the length of the menstrual cycle is predominantly driven by changes in the follicular phase (e.g. Mihm et al., 2011). As outlined in Chapter 1, current research has established that the luteal phase lasts for 14 days (Farage et al., 2008) and the relative stability of the luteal phase means that if cycle length is established it should be possible to reliably estimate where ovulation occurs.

As discussed in Chapter 1, and in the previous sections, the terminology used across the literature is inconsistent, does not agree on the length of menstrual cycle phases nor, does it fully take into account the variability in cycles. If the influences of ovarian hormones on female behaviour are to be accurately established, then greater clarity and consistency in methodology is required. The next section will review the range of possible methods that can be used to chart the female menstrual cycle and consider the relative strengths and weakness of each.

3.5 Methodology Employed for Identifying Phases

***Count Methods*:** The most common calendar based method is the count back method (e.g. Belanger et al., 2004; Brown et al., 2011; Garrett & Elder, 1984; Hicks-Little, Thatcher, Hauth, Goldfuss & Cordova, 2007; Little, Jones & Burris 2007; Wideman et al., 2013). Here participants are asked when their last menstrual period was and how many days are in their 'normal' cycle. For accuracy, participants are often asked to keep a menstrual diary in the weeks or months before taking part in experiments (e.g. Hicks-Little et al., 2007; Small, Manatunga & Marcus, 2007). The pre-ovulatory phase is the most variable, not only between females, but within individual females' menstrual cycles (Fehring et al., 2006). The luteal phase of the menstrual cycle has a fixed length of 14 days (Ecochard & Gougeon, 2000; Fehring, Schneider & Raviele, 2006; Hampson et al., 2014) making it a reasonably

reliable method for calculating ovulation (Epting & Overman, 1998). This fixed length allows researchers to count back and predict ovulation (if it occurs) with some degree of accuracy.

A forward count method can also be employed, and here females are asked to recall the first day of menstruation for their previous period. With this information, the experimenter counts forward 10 - 14 days from the onset of menses to predict ovulation (e.g. Belanger et al., 2004; Beynnon, et al., 2005; Little & Jones, 2012). Of course, this tends not to be as accurate as the count back due to the variability in length of the follicular phase (Epting & Overman, 1998; Hicks-Little, et al., 2007). Indeed, accuracy was investigated by Wideman et al. (2013) who measured two complete menstrual cycles across 73 females using hormonal assays to confirm menstrual cycle phases. They checked the reliability of both count back and count forward from the first day of menses to detect ovulation and found that count back determined ovulation for 59% of the sample while count forward determined ovulation in only 18% of the sample. However, when ovulation is confirmed using ovulation predictor kits, counting forward seven days from ovulation or backwards seven days from the onset of menses identified the peak progesterone surge in the mid-luteal phase in 67% of the sample. They do note however that due to variability in cycle length, that criterion levels of progesterone indicating the mid-luteal surge may have been missed as blood was not taken daily. Those with longer or shorter cycles may have reached criterion levels of progesterone out with blood sampling sessions.

Although they can be somewhat problematic, calendar based methods are still one of the most commonly used forms of fertility prediction for females trying to avoid pregnancy (Mosher, Martinez, Chandra, Abma, & Wilson, 2004). Count methods are simple and non-invasive so less likely to inconvenience participants. It does, however, involve some prediction based on the AMC with researchers having to estimate the days in a woman's cycle when ovulation is most likely to occur. Ovulation is generally estimated to take place between days 12 and 14 of the AMC, however, not all

females experience the AMC nor do they necessarily ovulate on those days in their cycle (Gordon, Corbin & Lee, 1986; Waller et al., 1998). A further problem is that this method is only useful if ovulation has actually taken place and evidence suggests not all females actually ovulate each month (Bauman, 1981; Hambridge et al., 2013; Metcalf & McKenzie, 1980). In an anovulatory cycle both estrogen levels are reduced by 25% and progesterone levels are reduced by up to 22%, so do not reach the same levels as in an ovulatory cycle (Hambridge et al., 2013). Levels are, however, raised in this phase, therefore any effects caused by estrogen or progesterone may be reduced but still evident. It should be noted, however, that in this study 500 menstrual cycles were measured and only 23 anovulatory cycles were recorded (i.e. 4.6% of possible cycles). If ovulation fails or a females stops taking hormonal contraceptives, then in the next menstrual cycle it can occur later than predicted for at least two cycles following (Nassaralla et al., 2011). Many researchers therefore ask participants about contraceptive use and require naturally cycling females to be free of contraceptives for three or more months prior to testing (Mordecai et al., 2008; Wright & Badia, 1999). Count methods may lack the reliability of more invasive methods such as hormonal assay when identifying ovulation, but when used in conjunction with other methods such as ovulation predictor kits they can be reliable in indicating when the mid-luteal surge of progesterone will occur.

***Body Basal Temperature*:** Another non-invasive method often used with the calendar methods is basal body temperature (BBT) (Belanger et al., 2004; Westhoff, Gentile, Lee, Zacur & Helbig 1996). Here participants take their temperature each morning during their cycle as body temperature varies according to stage in the cycle. For example, as ovulation approaches, a rise in estrogen causes body temperature to drop and once ovulation has occurred, a rise in progesterone causes temperature to increase (Lang Dunlop, Schultz & Frank, 2005). To use BBT successfully temperature must be taken following sleep and this should be at least three to six straight hours of sleep for accuracy (Pallone & Bergus, 2009). Temperature is charted daily and the woman is asked to watch for a rise of .4°. The

higher temperature will remain until the onset of menses. Charting is normally carried out over two or three cycles to establish a pattern and predict where ovulation is likely to take place (Beaudoin & Marrocco, 2005; Kasamatsu et al., 2002; Sakai & Ohashi, 2013; Simic & Ravlic, 2013). Once a pattern is established the timing of ovulation can be predicted.

As a method of predicting ovulation, BBT is less invasive than some of the more complex measures, although not all females show a marked change in temperature over their cycle. Vermesh, Kletzky, Davajan and Israel (1987) found that basal body temperature was only successful in predicting ovulation in 10% of the cycles they examined. In 70% of cycles examined ovulation took place in the three days following the day predicted by basal body temperature. Because the temperature rise happens after ovulation takes place, and this is not always consistent, accurately pinpointing ovulation using this method is difficult (Stanford & Dunson, 2007). For this reason, BBT tends not be relied on as a sole measure and is often one of several measures used by researchers (Colombo & Masarotto, 2000; Frank-Herrmann et al., 2007; Porucznik, Cox, Schliep & Stanford, 2014; Tawara, Tamura, Suganuma & Kanayama, 2012). For these reasons, BBT will not be used in these studies and alternative methods will be employed to predict where ovulation and the mid-luteal surge occur.

***Monitoring of Cervical Mucus*:** Cervical mucus is a viscoelastic gel that is made up of glycosylated hydrated proteins known as mucins (Brunelli et al., 2007). Cervical mucus goes through noticeable changes during the menstrual cycle and close monitoring of the mucus allows for successful prediction of ovulation (Scarpa, Dunson & Colombo, 2006; Stanford, Smith & Dunson, 2003). Estrogen causes cervical mucus to become thinner and less viscous in texture (Bigelow et al., 2004; Stanford et al., 2003) while progesterone thickens it to act as a blocking agent for sperm (Stanford et al., 2002). No cervical mucus is evident during menstruation nor is any detected for several days following menstruation (Brunelli et al., 2007). As ovulation approaches and levels of estrogen increase, the

volume of cervical mucus increases vastly becoming watery and clear (Alliende, Cabezon, Figuero & Kottman, 2005). Following ovulation, a drop in estrogen levels and an increase in progesterone acts on cervical mucus causing it to become thick and sticky (Stanford et al., 2003). Observation of cervical mucus can be an effective means of ovulation prediction but is very invasive and requires participants to undergo a period of learning to ensure they can identify the changes that indicate ovulation. As such it is not used as often as some of the other less invasive methods.

***Hormonal Assay*:** More accurate measures of the menstrual cycle tend to be more invasive with participants asked to provide saliva samples (Courvoisier et al., 2013; Duff & Hampson, 2000; Hampson et al., 2014; Roney & Simmons, 2008; Wright & Badia, 1999), urine samples (Feinberg et al., 2006), blood samples (Cherrier et al., 2002; Compton et al., 2008; Derntl, 2008; Halpern & Tan, 2001; Hatta & Nagaya), or both blood and saliva samples (Westhoff, Gentile, Lee, Zacur & Helbig, 1996). Once bodily fluids have been collected, hormonal assaying is carried out to provide a measure of hormone levels. While these methods provide the most accurate measures of hormone levels, they can be costly and time consuming, particularly if external assessment of samples is required. However, hormonal assay is becoming more accessible with a variety of kits available commercially. These can test a specific hormone or offer a more complex hormonal profile. For example, Chemiluminescence Immunoassy kits (LIA) or Enzyme-linked immunosorbent assay kits (ELIZA) are now both available to buy commercially although the cost remains high at around £300 each. A typical ELIZA kit for estradiol contains a set of wells (96 - 480) and estradiol anti serum, estradiol tracer, estradiol standard; two types of buffer (EIA buffer concentrate & washer buffer concentrate); Polysorbate 20 (a nontoxic detergent/emulsifier); plate coating (e.g. mouse anti rabbit); a well cover sheet, Ellman's reagent (causes colour change) and EIA tracer dye and anti-serum dye (Cayman Chemical Company, 2014).

There are two basic types of immunoassay, the sandwich type and the competitive type. ELIZA is an example of the sandwich type assay. Here two antibodies that are specific to the antigen sandwich it for detection. Typically, one antibody is a coating on the base of the plate on which the sample is placed and acts to bind the antigen before a second antibody is added effectively sandwiching the antigen. A chromogenic substrate is then added and this develops colour which is stronger when antigen levels are higher (Debnath, Prasad & Bisen, 2010). LIA is a competitive type of assay which works in a slightly different way. Here the antigen in a sample competes with an antigen conjugated to a reporter enzyme (this has the ability to amplify a weak signal) for antibody binding sites. Samples with high antigens generate a lower signal than samples that are low in antigens (Debnath, et al., 2010). If results are to be considered accurate, a strict protocol must be adhered to. In a 96 well plate each strip should contain two blank wells, two non-specific binding wells and an eight-point standard curve run in duplicate (Cayman Chemical Company, 2014). In addition to this, it is recommended that the assay is run twice or three times for accuracy which increases the cost of the process.

***Detailed Changes in Hormones across AMC using Hormonal Assay*:** Based on information gained from assaying urine, blood and saliva, a hormonal profile has been created for the average menstrual cycle. Typically, such studies ask females not using hormonal contraceptives to provide samples daily over the course of one or more menstrual cycles and these are assayed (Courvoisier et al., 2013; Munro et al., 1991; Stricker et al., 2006). Specific hormones are measured in terms of picograms per millilitre (pg/mL), a measure equivalent to one trillionth of a gram or nanograms per millilitre (ng/mL) a measure equivalent to one billionth of a gram. Levels of estrogen differ depending on phase with lowest levels in the early follicular phase ranging from 19 – 83 pg/mL, with highest levels towards ovulation ranging from 64 – 528 pg/mL, followed by reduced levels in the mid-luteal phase ranging from 60 – 211 pg/mL and in the late luteal phase these range from 55 – 150 pg/mL. Similarly,

progesterone levels differ across the cycle with low levels in the menstrual phase ranging from .2 – 1.4 ng/mL with levels increasing in the ovulation phase to ranges between 4.4 – 28 ng/mL and remaining relatively high in the late luteal phase with a range of 3.3 – 25.6 ng/mL (Beynnon et al., 2005). In an anovulatory cycle no LH peak is detected and peak progesterone levels are ≤ 2ng/mL (Pelusi et al., 2015). Evidence suggests urine and blood samples produce equally accurate hormonal profiles (Munro et al., 1991) while saliva samples have also been shown to accurately detect the LH surge that precedes ovulation as well as identifying estrogen and progesterone peaks (Alagendran, Archunan, Prabhu, Orozco & Guzman, 2010).

Based on the absolute accuracy of this method, then it is clear that measuring hormones provides the most accurate method for pinpointing when ovarian hormones are at their peak and this allows testing to take place during phases based on an appropriate sampling point for each and every individual. It is then the case that if behavioural effects are observed, the underlying hormone may be related to this. However, it is the case that not all researchers have access to this method so have to use alternative methods and also may combine one or two different methods to increase accuracy (Herrera et al.,1990; Lukaszewski & Roney, 2009; Solis-Ortiz & Cabrera, 2008; Wharton et al., 2008).

***Commercially Available Ovulation Testing Kits*:** An alternative method used by some researchers is using predictor kits to pinpoint ovulation (e.g. Epting & Overman, 1997; Kumar, Cantor, Allen, Riccardi & Cox, 2002; Miller & Soules, 1996; Wideman et al., 2012). These kits are commercially available and contain sticks that are dipped into the early morning urine of participants which change colour to indicate the LH surge prior to ovulation. This method provides an inexpensive, but reasonably accurate means of predicting where in the menstrual cycle ovulation occurs (Gildersleeve, Haselton, Larson & Pillsworth, 2012; Leiva et al., 2014).

Some caution is required when using this type of kit, as experimenters often have to rely on the participant being able to accurately interpret the test result (Wideman et al., 2012) and a false-positive rate of up to 7% has been reported in these measurements (McGovern et al. 2004). Advanced digital ovulation kits are becoming more readily available and these can reduce the chances of false readings (digital display indicating LH surge). Each kit contains a digital reader that is used with the ovulation dip strip. Once used, the strip is placed in the digital reader and the display will indicate when the LH surge has occurred. For example, Clear Blue Digital© claim to have over 99% accuracy, thus researchers can be confident that ovulation will occur within 24 to 36 hours. This allows for testing when estrogen levels are at their highest level so that behaviour in this phase can be observed and compared with behaviour in phases when estrogen is at lower levels.

3.6 Summary

The most accurate method of identifying menstrual cycle phase is daily hormonal assessment but this is not an option available to all researchers. The method is however highly invasive, very expensive and prone to very high attrition rates, particularly where daily measurements are required. More basic methods such as self-report, count or BBT can be combined to increase the accuracy of ovulation detection (Solis-Ortiz & Cabrera, 2008; Wharton et al., 2008). Once ovulation has been detected forward and/or backward count can be used to predict where in the luteal phase the progesterone surge will occur. Ovulation kits can also be used in combination with count methods to provide a more accurate prediction of ovulation. These methods are quick, inexpensive and non-invasive so should be more attractive to potential participants than methods that are time consuming and require invasive procedures such as repeated sampling of blood, urine or saliva. This means that to chart the menstrual cycle with any accuracy, or at least to be able to help validate any other method, ovulation should be identified (Gildersleeve et al., 2012; Leiva et al., 2014). Once ovulation is established count

methods can be used to chart the menstrual cycle phase more accurately. If 'typical' time of ovulation can be identified in menstrual cycles of different lengths, then predicting where in the mid-luteal phase the progesterone peak is estimated to occur when cycles vary can also be more accurately achieved. This will allow the development of a three phase testing schedule where it will be possible to make use of the count back method to determine when to test each individual, without the need to test for ovulation each time, which would potentially deter participants (see Chapter 2). Therefore, it is the intention of the next part of this chapter to test and validate a methodology for the the empirical work (Chapter 4), so that participants can simply be asked about the length of their menstrual cycle, so that test dates for each phase can be calculated specifically for them.

3.7 Validation Study: Pinpointing Ovulation Using Ovulation Kits (Simple and digital) and a proposed three phase testing schedule

3.7.1 Test phases

Phase 1: Simple Ovulation Predictor Strips: In the first phase of the study simple (urine dip strip) ovulation predictor strips were used to confirm where ovulation occured in a natural menstrual cycle. Participants were asked to complete a menstrual cycle chart over three complete cycles so that length of cycle could be recorded, as well as the variability of individual cycles. Ovulation strips were used for three days to see if a LH surge could be detected. Day of testing was again based on self-reported menstrual cycle length with participants who indicated they had a short cycle (≤26 days) asked to start using the kits earlier in their cycle than participants self-reporting longer cycles (≥ 30 days).

***Phase 2: Digital Ovulation Predictor Kits*:** As mentioned above (Section 3.4.7) Digital Ovulation Predictor kits are potentially more accurate than the 'simple' test sticks and so a second phase was added. Participants were asked to complete a menstrual cycle chart over three complete cycles so

that length of cycle could be recorded. Digital ovulation kits were used for up to five days across three menstrual cycles to discover if a LH surge could be detected. Days assigned for testing were again based on self-reported menstrual cycle length.

***Aim of study*:** The aim of this pilot study was to use inexpensive, commercially available ovulation kits to detect a LH surge (an indication that ovulation will occur within 24 – 36 hours) which would allow a systematic charting of where ovulation takes place in cycles of different lengths. Confirming where ovulation occurs in different lengths of menstrual cycles is an important first step for this thesis, as it allows initial validation of an estimated testing window for the high estrogen peak at ovulation. If this is achieved then it makes it more likely that the mid-luteal phase will be accurately estimated, allowing for testing which can hopefully capture the progesterone surge. In short, knowledge of when ovulation 'usually' occurs in menstrual cycles of different lengths will allow more accurate estimation of when the progesterone surge will occur in the mid-luteal phase. The information will then be used to calculate a three phase testing schedule for individual participants based on their menstrual cycle length. This is vital as the testing window is different for different lengths of cycle, and it is important for this to be accurate across all these individuals regardless of absolute length of cycle. For example, Figure 3.1 shows that in shorter menstrual cycles ovulation occurs earlier in the cycle than in longer menstrual cycles. In both short and long cycles, the follicular phase is where the actual variation occurs. In all cycles the luteal phase does not tend to vary and is always approximately 14 days long (Hampson & Young, 2008; Howards et al., 2008; Wallace et al., 2010) with the mid-luteal progesterone peak occurring seven days after ovulation.

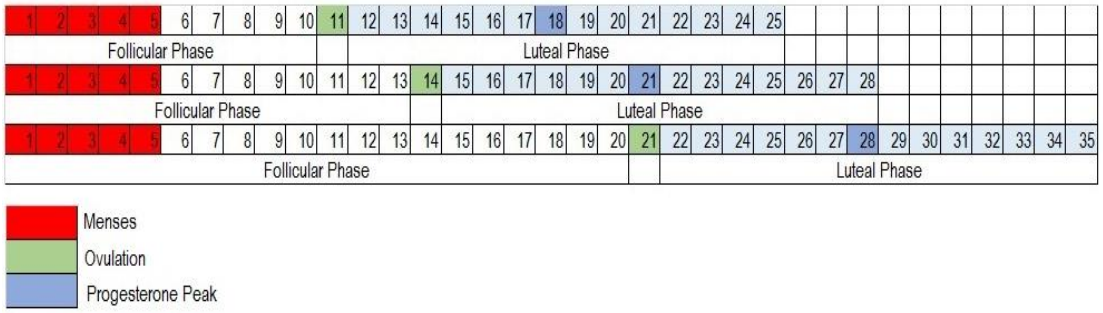


Figure 3.1 Showing expected day of ovulation and day of peak progesterone for an example short (25 day), average (28 day) and long (35 day) menstrual cycle.

Figure 3.1 represents the day of expected ovulation for females experiencing a menstrual cycle within what is regarded as a 'normal' menstrual cycle falling between 21 days and 35 days in length (Dasharathy et al., 2012; Hambridge et al., 2013; Mihm et al., 2011).

3.8 Method.

Participants

***Study 1. Simple ovulation urine dip strips*:** Females free of hormonal contraceptives for three months or longer were recruited to take part in the study (defined from this point onwards as 'naturally cycling females'). Each participant was asked to use simple ovulation detection kits (test strip to dip in urine) in three complete menstrual cycles. Twenty-three naturally cycling females were recruited from students and staff at Abertay University and 24 naturally cycling females were recruited from the Psychology Postgraduate Affairs Group (PsyPag), a grouping of postgraduate psychology students who hold an annual conference and publish selected postgraduate student papers. A total of 47 females (mean age 32.2 years) began the study, however, not all participants completed three full cycles of testing and nine did not return any charted cycles. This resulted in a total of 48 charted menstrual cycles, 22 of which showed no LH surge.

***Study 2. Clear Blue Digital© Ovulation Predictor* Kits:** Nineteen naturally cycling females were also recruited to use more reliable digital ovulation kits to further establish where ovulation occurs in menstrual cycles of different lengths. Participants were given Clear Blue Digital © kits and asked to use for three to five days in each of three menstrual cycles. The increase in the number of days to use the predictor kits was in response to high number of cycles where a LH surge was not recorded being returned by participants using the simple ovulation sticks. A total of 19 females (mean age 35.3 years) began the study however not all participants completed three full cycles of testing. This resulted in a high number of cycles where no LH surge was recorded.

Overall 66 females (mean age 33.7 years) were recruited over both studies to chart their menstrual cycles and note where in each cycle a LH surge was detected. Over both studies a total of 89 menstrual cycles were charted, with 29 showing no LH surge.

Table 3.4 Number of short, average and long menstrual cycles for stick and digital ovulation kits

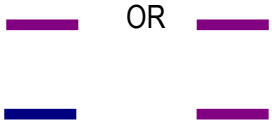
Cycle length in days		Stick	Digital
	Total cycles	5	11
	LH detected	1	9
	Total cycles	25	23
	LH detected	15	20
	Total cycles	18	7
	LH detected	10	5

***Materials and Apparatus*:** A participant information sheet (see Appendix 3.1) outlining the aim of the study and the commitment required from participants was provided. A menstrual cycle chart (see Appendix 3.2) covering three months, showing the date and giving a space to note which day of the menstrual cycle the participant was experiencing was utilised. Participants were instructed to label day one of menstruation as the first day of their cycle and to number the following days until their next period when the day count would return to day one. Based on self-reported cycle length, participants

were given three days (four in phase 2) in their cycle to use the ovulation kits and were asked to indicate on the chart if a positive result was found. Some participants however, used the kits for more than three days in error and were sent additional test strips and a reminder only to use these for three days in the remaining cycles. Instructions on how to read the results from the ovulation kits were also provided (see Appendix 3.3). A short demographic questionnaire (see Appendix 3.4) containing 10 questions was also included that asked participants about their number of pregnancies and length and regularity of menstrual cycle. For participants residing outside the local area, a stamped addressed envelope was also provided for the return of unused materials and completed menstrual charts.

***Simple Ovulation Kits*:** Advance LH ® ovulation kits manufactured by Altas Link (Beijing) Technology Ltd were used. These are immuno-chromatographic in vitro assays designed to detect the LH surge prior to ovulation. Each pack contained one LH ovulation strip and results were displayed as colour bands on the strip. The indication for a positive result (LH surge) was denoted by the test line appearing as a matching colour or shade darker than the control line. The control line was displayed above the test line.

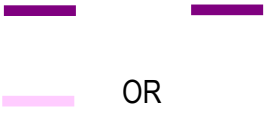
e.g. Control line Test line OR Control line Test line



A negative result (no LH surge detected) was indicated by a test line that was lighter in colour than the control line or only the control line present with no test line apparent.

Control line Control line

e.g. Test line OR Test line absent



Participants were given written instructions (see Appendix 3.3) which detailed how and when to use the ovulation strips and with colour coded instructions as to how a positive result and negative result would appear.

Clear Blue Digital© Ovulation Predictor Kits: These digital ovulation kits also detect the LH surge that occurs prior to ovulation. However, rather than a simple colour change, the test stick is placed into a digital reader that displays a smiley face (☺) when a LH surge is detected. If no LH surge occurs the display shows an empty circle (◯). Clear Blue Digital© claim over 99% accuracy in detecting a LH surge and predict ovulation will occur 24 to 36 hours following a positive test result (www.clearblue.com).

Procedure

***Simple Ovulation Strips*:** Participants were asked to complete a menstrual chart for three full menstrual cycles and to use ovulation strips for three days in each cycle. Testing over three days was selected to allow for the variability in length of the follicular phase (Epting & Overman, 1998; Hicks-Little, et all., 2007). Days for using these were based on the self-reported cycle length of participants. Those reporting average 28-day cycles were asked to use the kit on days 13, 14 and 15 of their cycle (see Figure 3.1). Those reporting shorter or longer menstrual cycles were asked to use the kits earlier or later in the cycle. The shortest reported cycles were 26 days and these participants were asked to use the kits on days 12, 13 and 14 of their cycles. The longest reported cycle was 34 days and this participant was asked to use the kits on days 20, 21 and 22 of their cycle. Once the chart was completed for three menstrual cycles, participants returned these to the experimenter. Not all participants adhered to the three-day testing schedule and two participants contacted the experimenter to request more ovulation kits following using all kits during their first cycle. Completed menstrual

cycle charts indicated that two other participants tested on four or five days in one cycle. Seven other participants requested additional test strips having used more in the first cycle than has been requested. This resulted in some participants recording a LH surge earlier or later than self-reported cycle length would predict and suggest that the follicular phase did vary for some participants or indeed that there was some inaccuracy in reporting of cycle length. A total of 48 menstrual cycles were charted, with cycle length ranging from 26 days to 34 days. In 21 of these cycles no LH surge was recorded and of those 15 data points were attributable to 5 participants who recorded no LH surge in any of the three test cycles. Cycle length varied from 1 to 3 days within participants with the highest variability shown in those five participants who recorded no LH surge across the three test cycles.

***Clear Blue Digital© Ovulation Predictor Kits*:** As with the previous study participants were asked to self-report cycle length and test dates were based on where ovulation would be predicted to occur for that cycle length (see Figure 3.1). The shortest reported cycle was 23 days and this participant was asked to use the kits from days 9 to 13 of their cycle. The longest reported cycle was 33 days and this participant was asked to use the kits from 19 to 23 of their cycle. Participants were asked to stop using the ovulation kits as soon as a LH surge was detected but to stop after five days if none were detected. In this study one participant used all materials in a single cycle and was provided with additional materials for the remaining test cycles. A total of 41 cycles were charted and of these seven recorded no LH surge. Three of these were from a single participant who recorded no LH surge in any of three cycles.

Previous studies have categorised cycle length differently, although most agree that a short cycle is ≤ 26 days. Previous research considers a normal (average) menstrual cycle as being between 26 – 35 days in length (Small, Manatunga & Marcus, 2007; Mumford et al., 2012). Menstrual cycles longer than 35 days in length are often considered as long cycles. However, the present study decided to

take a more conservative approach categorising the cycle length slightly differently – grouping cycles into three categories according to length: short (≤ 26 days), average (27 – 29 days) and long (≥ 30 days) to examine whether ovulation was taking place at the expected time for short, average and long cycles. In shorter menstrual cycles the follicular phase is short while in longer menstrual cycles the follicular phase is longer than in the average 28-day cycle. As previously mentioned the luteal phase does not vary dependent on cycle length (Mihm et al., 2011) and this allows the mid-luteal phase to be pinpointed with a relatively high degree of accuracy once the point of ovulation has been established. The progesterone peak occurs seven days consistently following ovulation.

3.9 Results

Results were initially examined in terms of whether a LH surge was recorded or not. For each cycle where a LH surge was recorded, ovulation was predicted to occur one day later than this surge, and this day of ovulation was then examined to see if this occurred at the time expected for that cycle (Figure 3.1). For example, for a 28-day cycle, ovulation was predicted to occur on day 14, so a measure of ± 1 day would allow ovulation on days 13-15 to be counted as occurring within the expected window. This is a vital component of the pre-testing – does ovulation occur at all, and if it does, is it at the predicted day based on the cycle length? The assumption that ovulation occurs at a fairly predictable time for a cycle of a specific length, needs to be tested, so that the more reliable 14-day luteal phase can be calculated

***Simple Ovulation Strips*:** A total of 48 menstrual cycles were charted, with cycle length ranging from 26 days to 34 days. Testing demonstrated a total of 26 ovulatory and 22 anovulatory cycles, suggesting that only 54% of the cycles demonstrated a LH surge. Of the 26 cycles with a LH surge, sixteen (62%) of those indicated that ovulation occurred at exactly the expected time. Twenty-three

(89%) of the cycles showed actual ovulation occurred within ± 1 day of the expected day based on the estimated testing protocol. One cycle (returned by participants using the ovulation kits for longer than requested) showed a LH surge occurring three days earlier than expected for the cycle length and one cycle showed a LH surge occurring two days later than expected. This suggests that sample cycle length may have been more variable within participant than was expected, however as table 3.5 shows, most participants were accurate in their self-reported cycle length.

Table 3.5 Reported and recorded menstrual cycle length for participants using simple ovulation predictor kits

Simple predictor kits					
Reported length	Cycle	First recorded cycle length	Second recorded cycle length	Third recorded cycle length	Average for two or more cycles
23		24			
24		25			
26		24			
26		25			
27		26			
27		27	27	28	27.3
27		27			
27		27			
27		27			
27		27			
28		28	28		28
28		28	27		27.5
28		29			
28		29			
28		28			
28		28	27		27.5
28		28			
28		29			
28		28			
28		29			
27		28	26		27
28		28			
29		27	26		26.5
27		30			
28		31			
28		30			
28		31			
28		30			
29		30			
30		30			
30		30			

30	30	31	30.5
30	30		
31	31		
32	31	31	31
32	31		
33	33	32	32.5
33	34		

As table 3.5 shows cycle length varied little between the self reported and recorded length, ranging from 1 to 3 days (self reported length =/-.97 days) within participants, with the highest variability shown in those participants who did not record a LH surge in the expected window across the three of their test cycles. In this sample five (10%) charted cycles were categorised as short cycles; 25 (52%) were categorised as normal (average) and 18 (38%) were categorised as long. Although participant attrition was high, it should be noted that participants' self-reported and actual cycle length were very close making the data reliable. Asking participants to complete three full cycles was intended to show how reliable self-report was amongst participants. Those who did complete two or more cycles did not vary in cycle length by more than three days, with the majority of participants (93.6%) accurate to within ± two days confirming that participants can estimate their cycle length with a relatively high degree of accuracy.

***Clear Blue Digital© Ovulation Predictor Kits*:** Nineteen naturally cycling females were recruited to use more reliable digital ovulation kits to further establish where ovulation occurs in menstrual cycles of different lengths. This data suggests this was a more accurate methodology, as 83% of recorded cycles were ovulatory. Or being more conservative, 15 out of 19 participants (79%) were recorded as ovulating during the testing period.

Table 3.6 Reported and recorded menstrual cycle length for participants using simple digital ovulation predictor kits

Digital predictor kits					
Reported length	Cycle	First recorded cycle length	Second recorded cycle length	Third recorded cycle length	Average for two or more cycles
23		26			
26		25	26		25.5
27		26	26	27	26.3
27		26	26		26
28		28	30		29
27		29	31	30	30
28		28	28	28	28
28		27			
28		28	28	28	28
28		28	28		28
28		28	28	27	27.7
28		28	29		28.5
28		28	29	28	28.3
28		26	27		26.5
28		28			
29		30	29	29	29.3
30		28	30		29
30		30	29		29.5
30		33			

As table 3.6 shows not all participants completed the full three cycles (7 from 19) and information for an additional 41 cycles was collected. Cycle length ranged from 23 days to 33 days and seven cycles failed to record a LH surge. Self-reported cycle length was similar to recorded length in the majority of participants with the difference ranging from 1 – 4 days. In total 17 participants (89.5%) recorded menstrual cycle length of ± 1 day of self-reported cycle length. Three of those cycles where no LH surge was recorded came from a single participant who did not record a LH surge in any reported cycles. Considering both samples, it would seem that asking women to self-report cycle length is a valid choice and produces reliable results. In total 91.3% of participants were within ± 2 days of their self-reported cycle length.

As before, cycles were categorised by length, eleven (27%) cycles were categorised as short, 23 (56%) were categorised as normal (average) and seven (17%) were categorised as long. Sixteen cycles (46%) recorded a LH surge at exactly the expected time for the length of cycle (i.e. one day before the predicted day of ovulation, such as day 13 on a 28-day cycle). Based on the detection of a LH surge, 26 cycles (74%) showed ovulation occurred within ± 1 day of the expected day. Thirty-two (91%) cycles showed that ovulation occurred within ± 2 day of the expected day for that cycle length. One cycle showed ovulation took place three days later than would be expected. Two menstrual charts were returned showing ovulation occurring much earlier than expected, the first four days earlier than expected and the other five days earlier than expected. In both cases participants used all ovulation sticks in one cycle. In total, most of the participants using this methodology detected a LH surge, with three quarters of participants ovulating within ± 1 day of their predicted day.

***Combined Results*:** Over the two independent testing phases (simple ovulation strips and digital ovulation kits) 89 cycles were charted. Fifteen (17%) cycles were categorised as short, 49 (55%) were categorised as average and 25 (28%) were categorised as long. Of the total cycles returned 29 (33%) showed no LH surge had been detected. However, eighteen of these cycles came from six participants who failed to record a LH surge in any of the three test cycles. This suggests an inaccuracy of the testing process or failure to ovulate regularly in these participants. Alternatively, these participants might be ovulating outside of the testing phase due to long or short cycle length. Of the remaining cycles that recorded no LH surge, these came from participants who recorded a single cycle with no LH surge detected.

Evidence suggests that anovulation can affect up to 7% of women with normal length menstrual cycles but can occur more frequently in women who experience shorter or longer menstrual cycles (Mihm et al., 2011). Over the two test phases, of those who detected no LH surge in all three cycles, only one

those (3%) was in the 27 – 29-day cycle category, with the remainder in the short (3%) and long (10%) cycle categories. Of the 60 ovulatory cycles recorded, 32 (53%) indicated ovulation took place at exactly the expected time for the cycle length. Again based on detection of a LH surge, a total of 49 (82%) participants ovulated within ± 1 day of the expected day and 56 participants (93%) showed ovulation took place within ±2 days of the expected day. Of the remaining ovulatory cycles, three recorded earlier than expected ovulation (3 days, 4 days and 5 days) and the remaining cycle was three days later than expected. As previously stated, these cycles were recorded by participants who used all of the ovulation kits in a single cycle. This suggests that in those cycles where no LH surge was recorded, ovulation may still have occurred, but took place earlier or later in the cycle than would be predicted my cycle length.

3.10 Discussion

Results from this study indicate that commercially available ovulation kits can provide a useful aid to predicting menstrual cycle phases. Both methods successfully detected the LH surge that precedes ovulation in around two thirds of the participants. However, it is clear that the rise to around 85% when using the digital kit suggests that the majority of participants are indeed ovulating across most cycles and in the expected timeframe. This is slightly less than was found in a large study which utilised the even more accurate serum hormonal measurement. Here, Mumford et al. (2012) found that only 42 out of the 509 cycles measured (8.3%) were anovulatory, suggesting that ovulation occurs in healthy females in more than 90% of cycles. In this study there were higher numbers of cycles where no LH surge was recorded and this may in some part be due to the use of simple dip sticks as a means of detecting a LH surge. Alternatively, it may be that some of the participants ovulated earlier or later than might be expected and missed the LH surge when using the ovulation kits. Participants who used all sticks in one cycle were found to ovulate earlier or later than had been predicted by their cycle

length and this warrants further investigations with longer testing required. The majority of participants however did ovulate at or close to the predicted time and this supports the contention that the present thesis's first assumption of an ovulatory cycle for most participants is supported by both the results of this study and the evidence from other more accurate studies.

In terms of cycle length, the majority of recorded cycles (55%) fell into the average cycle length (27-29 days), followed by the long category and only about one fifth were in the short category. Mean cycle length was 28.3 days (SD ± 1.96) which fits with data from Mumford et al. (2102) who had a mean cycle length of 28.3 days (SD ± 4.1), median of 28 days and a range of between 13 and 58 days. This suggests that a significant proportion of cycles measured in the study are indeed approximately following the hypothetical average cycle.

The second assumption of this thesis is that the stability of the luteal phase (around 14 days – e.g. Mumford et al., 2012,) means that if an accurate determination of the day of ovulation can be achieved, then seven days after this point will capture the mid-luteal surge of progesterone (and the second attenuated peak of estrogen) (see Chapter 1 Section 1.2 and Figure 3.1). For the next part of this study, the consequences of the accurate detection of ovulation will be modelled against the average menstrual cycle, to examine the influence of the proposed testing schedule on the likely level of hormones at this point.

Consequences of Ovulation Day for "Mid-luteal Phase" estimate in an average 28-day cycle:
As indicated previously, it is assumed that if ovulation is accurately pinpointed, the midpoint of the luteal phase can also be predicted with a high degree of accuracy. As the first part of this study suggests that most cycles have a LH surge and ovulation occurs at around ± 1 day of the expected day (based on the cycle length), it is appropriate to investigate the effect that this variation may have

on the estimated mid-luteal point. The first examination of this is based on the dates that will be used for a 28-day cycle (representative of the average cycle length) and has the goal of examining what the potential consequences for this thesis would be if ovulation was a day either side of the 'average' day 14 that is used as the benchmark. The first thing to note is that although the mid-luteal progesterone peak occurs seven days after ovulation, importantly the peak lasts much longer than 24 hours and is already at a relatively high level from day 19 with high levels sustained until approximately day 24 (see Figure 3.2). The luteal peak of estrogen although not as high as either progesterone or its' own earlier pre-ovulation peak, does follow a similar trajectory being a minimum of 80% of peak during the same period (Figure 3.2). This means that slight inaccuracies in terms of actual day of ovulation can still lead to a relatively high level of both hormones and is very forgiving of these inaccuracies.

To illustrate this more clearly, it is useful to view this on an average 28-day cycle. Figure 3.2 shows that participants who self-report an average 28-day cycle should ovulate on day 14 of their cycle then experience the mid-luteal surge on day 21. Even if actual ovulation occurs up to two days earlier or later, then the mid-luteal testing day (21) would still capture the five-day window of elevated hormones. For example, if ovulation was two days earlier (day 12) then testing on day 21 would see the testing carried out two days after the peak (equivalent to the levels shown at day 23 on the diagram) and both hormones although beginning to decline would still be raised. Conversely, if actual ovulation was two days later (day 14) then day 21 testing would be two days before the peak (equivalent to the levels shown at day 19 on the diagram) and both hormones although in the process of increasing would still be at an elevated level at this testing point. Also, as the majority of ovulations (circa 90%) occur within two days of the hypothesised day used in the testing schedule proposed for this thesis (see Section 3.8), then testing around seven days after this time should capture elevated levels of both progesterone and estrogen in the mid-luteal phase. For this reason, it is suggested that a testing window of two - three days around day 21 would allow an excellent opportunity to capture elevated

levels of both hormones in the mid-luteal phase, even if actual ovulation did not occur on day 14. Some caution should be taken however, given that the there was some variability between self-reported and recorded cycle length. Additionally there were a high proportion of cycles where no LH surge was recorded and data from participants who wrongly used all kits in a single cycle indicated that it is possible that a LH surge did occur, but may have taken place earlier or later in the cycle than had been predicted.

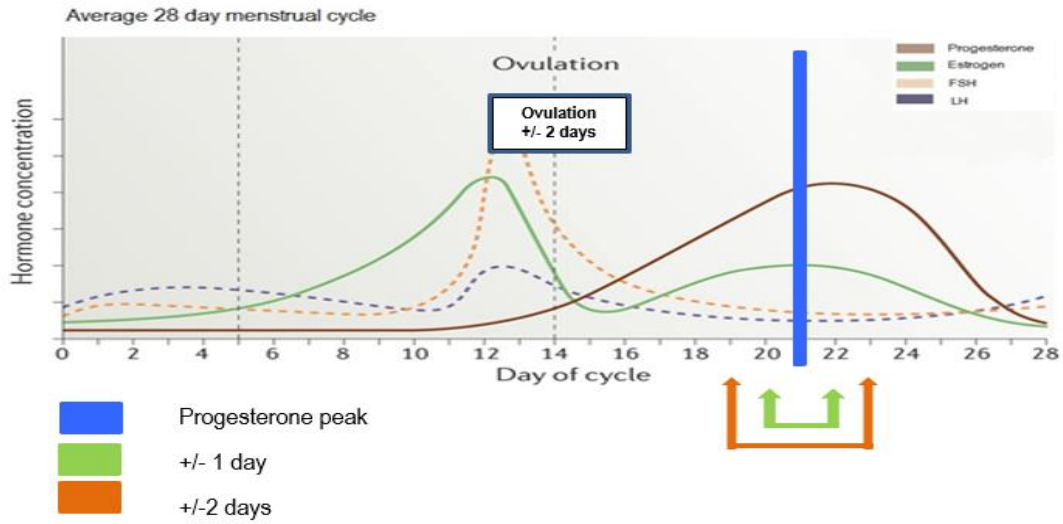


Figure 3.2 showing mid-luteal phase and progesterone and estrogen levels in an average 28-day cycle.

It is strongly argued that the stability of the luteal phase of the menstrual cycle allows for accurate identification of the midpoint of the luteal phase. The mid-luteal peak progesterone surge occurs seven days following ovulation and levels remain elevated for three to four days before dropping again as menstruation approaches (Farage et al., 2008; Mihm et al., 2011). In this study 93% of participants ovulated within ± 2 days of the day predicted for ovulation for their self-reported menstrual cycle length. This would suggest that predicting ovulation based on self-reported menstrual cycle length is reliable and can be used to predict where the mid-luteal progesterone peak will occur.

***Consequences of Ovulation Day for "Mid-luteal Phase" estimate in other cycle lengths*:** Data collected for the pilot studies suggests that of those cycles that were ovulatory more than 90% of cycles had ovulation occur within ± 2 days of the day predicted for their menstrual cycle length. However, although 52% of the sample had a cycle length of 27 - 29 days and so fits nicely with the 28-day cycle described in Section 3.7.1, it is appropriate to examine the effects of both shorter and longer cycles on the proposed testing schedule. As mentioned before, testing seven days after expected ovulation should ensure most ovulatory participants are tested on days when progesterone levels are raised. From Figure 3.1 it is clear participants who self-report experiencing a 25-day menstrual cycle will be expected to ovulate on day 11 and their mid-luteal phase peak would be around day 18. Participants who self-report experiencing a 35 day menstrual cycle should ovulate around again on day 21 with their mid-luteal phase progesterone peak at around day 28. Similar, to the figures used to illustrate a 28-day cycle, Figure 3.3 shows the effect that a ± 1 day variation in actual day of ovulation will have in a short (25 days), average (28 days) and a long cycle (35 days).

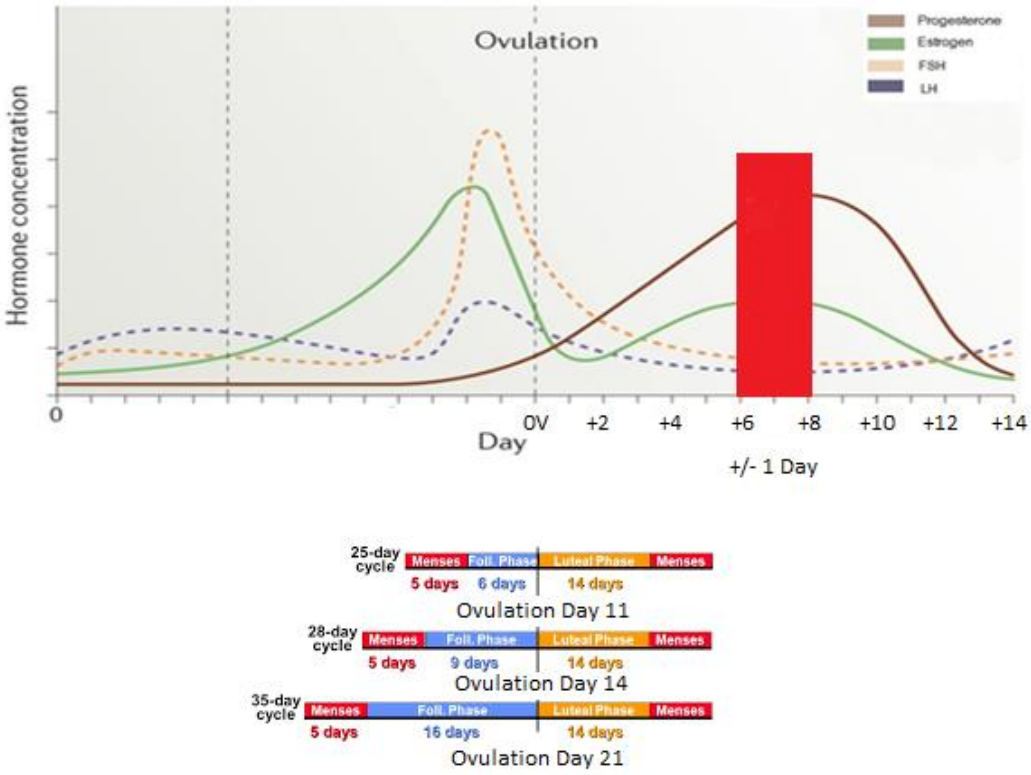


Figure 3.3 Illustration allowing for ± 1 day variation in actual day of ovulation.

The lower part of the Figure 3.3 shows that the variation in length for long and short cycles is primarily in the pre-ovulatory part of the cycle. For all cycles, the upper part of the diagram illustrates that the luteal phase is fixed at around 14 days, and for each cycle, although the actual day of ovulation is different, the progression through the last 14 days is assumed to be identical (e.g. Mihm et al., 2011). The red band illustrates the relative levels of luteal hormones that would be circulating if the actual ovulation was either one day earlier or later than expected (OV) and this would apply whether the cycle was short, average or long. As the pilot study suggested that the majority of ovulations were within ± 2 days of the expected window then extending the band by another day either side would still hit high levels of both progesterone and estrogen. This supports the second major contention that the estimation of a mid-luteal point of around seven days after predicted ovulation and would seem to be a robust estimate of a high level of hormones, regardless of whether actual ovulation was exactly on the predicted day.

3.11 Testing Phase Names and Testing Schedule used in the Current Thesis

As the pilot study demonstrated regular ovulation where a LH surge was recorded (when accurate measurement instruments were used), which occurred very close to the 'expected' day calculated from cycle length (Figures 3.2 & 3.3), a testing schedule was created (Table 3.1). All test phases for the experimental chapter (Chapter 4) will be based on self-reported menstrual cycle length, without a specific measurement of hormones and/or ovulation, as this was found to be an accurate assessment of when ovulation would occur in the majority of cases. Some research is critical of using self-reported menstrual cycle length (e.g. Small et al., 2007), however, Jukic et al. (2008) asked 352 women to complete daily menstrual diaries for a six-month period and compared self-reported cycle length with observed cycle length and found that, on average, participants overestimated cycle length by only .7 days. Importantly, if the current sample makes a similar overestimation on cycle length, testing for the

mid-luteal phase if carried out seven days later will still take place when progesterone and estrogen levels are at a higher level (Figure 3.2).

Testing phases for this thesis will be referred to as the menstrual phase, ovulatory phase and the mid-luteal phase. The choice to use mid-luteal as the name for the final testing phase is based on this being the name most commonly used by researchers testing in the midpoint of the luteal phase (e.g. Epting & Overman, 1998; Hatta & Nagaya, 2009; Hausmann, 2005; Simic, Tokic & Pericic, 2010; Simic & Santini, 2012). When examining mood and well-being participants will be asked to complete questionnaires once during the menstrual phase (days two - four), once during the ovulatory phase (based on self-reported cycle length) and once in the mid-luteal phase (seven days after predicted ovulation). Based on the information gained from this study testing phases will be assigned to participants based on their menstrual cycle length using the count back method to predict ovulation in subsequent cycles (see Section 3.1.4).

It is not anticipated that any participant will report a menstrual cycle shorter than 21 days or longer than 35 days, however, test dates can still be calculated for anyone who reports such cycles. Testing in the menstrual phase will be carried out between the second and fourth day of menstruation, with a rationale of avoiding the first day of menstruation, when some females experience pain or discomfort. Test dates for the ovulatory phase and the mid-luteal phase will depend on menstrual cycle length and count back will be used to establish when these are most likely to occur. In order to give a realistic window of testing, the dates will be based on the date of expected ovulation, plus 2 days after this predicted date (e.g. for a 28-day cycle, ovulation is predicted on day 14 and so testing will be from then until day 16). Mirroring this three-day window, mid-luteal testing will also follow a similar pattern sampling between the expected mid-luteal peak and the subsequent two days (e.g. for a 28-day cycle, predicted as day 21 and so the window for testing will be from then until day 23). Table 3.1 clearly

shows the testing days for cycles ranging from 24 to 35 days. In order to be as accurate as possible, count back will be based on luteal length as this phase is fixed (see Section 3.4.1) in comparison to the follicular phase. Most researchers agree that the luteal phase is 14 days in length (e.g. Cole et al., 2009; Ecochard & Gougeon, 2000; Fehring et al., 2006) and based on this ovulation can be predicted to occur 13 – 14 days before the next cycle begins. The progesterone surge normally occurs at the midpoint of the luteal phase which is seven days prior to menstruation (Hampson & Young, 2008; Howards et al., 2008; Wallace et al., 2010) so testing in the mid-luteal phase will take place approximately seven days after ovulation.

Table 3.5 Three phase testing schedule used throughout this thesis for different menstrual cycle lengths.

Cycle length	Menstrual phase test days	Ovulatory phase test days	Mid-luteal phase test days
24 days	2 - 4	10 – 12	**17 – 19**
25 days	2 - 4	11 – 13	**18 – 20**
26 days	2 - 4	12 – 14	**19 – 21**
27 days	2 - 4	13 – 15	**20 – 22**
28 days	2 - 4	14 – 16	**21 – 23**
29 days	2 - 4	15 – 17	**22 – 24**
30 days	2 - 4	16 – 18	**23 – 25**
31 days	2 - 4	17 – 19	**24 – 26**
32 days	2 - 4	18 – 20	**25 – 27**
33 days	2 - 4	19 – 21	**26 – 28**
34 days	2 - 4	20 – 22	**27 - 29**
35 days	2 - 4	21 – 23	**28 - 30**

Table 3.5 represents the days on which testing will take place in menstrual cycles of different lengths. Once recruited, participants will be asked about the length of their menstrual cycle and test dates will

then be tailored to the individual based on days shown in Table 3.1. Hormonal contraceptive users will also be recruited to investigate behavioural differences between the groups (See Chapter 4, section 4.2). Hormonal contraceptive users who menstruate experience a 28-day cycle and can be assigned to test phases based on their last menstruation. Females who do not menstruate due to contraceptive type (LARC's) and cannot recall their last menstrual period will be treated as if they have a 28 day cycle length. They will be randomly assigned to a phase for the first testing session and subsequent test dates will be based on this. For example, a contraceptive user assigned to the first testing session in the "mid-luteal phase" will be considered to be on day 22 of their cycle and asked to return eight days later for the "menstrual phase" then again 12 days later for the "ovulatory phase" test session.

***Summary*:** The aim of this chapter was to evaluate methods used to measure the menstrual cycle with the intention of identifying an accurate and reliable means of estimating the progesterone and estrogen surges that occur in the mid-luteal phase. Count methods may seem basic but they remain one of the most popular ways of measuring the menstrual cycle (Belanger et al., 2004; Beynnon, et al., 2005; Brown eta l., 2011; Garrett & Elder 1984; Hicks-Little et al., 2007; Little & Jones, 2012; Little, Jones & Burris, 2007; Wideman, et al., 2013). If based on cycle length and the luteal phase these methods provide an inexpensive and non-invasive way to predict when hormonal surges occur. Ovulation kits are ideal for pinpointing ovulation and this study has confirmed when ovulation takes place in menstrual cycles of different lengths and established that the majority of participants (93%) were ovulating within +/2 days of the expected date. Count back methods based on the established length of the luteal phase allows for a confident prediction of the mid-point. Based on this, an accurate prediction can now be made as to when testing in the mid-luteal phase should occur (Table 3.5) and will be used as the method of determining testing phases Chapters 4. It should be noted however that there was a high number of cycles where no LH surge was recorded, therefore, caution will be

required when interpreting any findings related to hormonal surges. The high number of cycles failing to detect a LH surge may be an indication that for some women the correct testing phases might be missed and any effects diminished as a result. Further testing with large numbers of females charting cycles should be carried out using digital ovulation kits to fully establish the variability of participant's cycles prior to testing.

3.12 Conclusion

Results show that the three proposed test phases can potentially be predicted with a high degree of accuracy based on participants' self-reported menstrual cycle length. Perhaps more importantly, it has demonstrated that the testing schedule is robust and can withstand some deviation from the averages without invalidating the underlying assumptions about hormone levels in each phase. Arguably, due to the stability of the luteal phase, and the length of time that hormones are elevated, the testing schedule in this phase is very likely to represent the influence of high levels of both estrogen and progesterone. This was a vital first step in the current research and allows confidence in the fact that although the phases of testing were indeed based on averages, (and not measures of either hormone levels or ovulation days for all individuals), that this does represent a solid proxy measurement system.

During recruitment, all participants will be asked to self-report menstrual cycle length and the day of ovulation will be predicted based on this. As indicated above, the mid-luteal progesterone peak occurs seven days after ovulation so participants will be tested around this time in order to capture the progesterone surge. There is a risk that some participants may have an anovulatory cycle which will lead to reduced levels of estrogen and progestrerone in the luteal phase (Mihm et al., 2011). However,

although the levels of hormones are reduced in anovulatory cycles, they continue to fluctuate and it seems that although effects are diminished they may remain detectable (Hambridge et al., 2013).

In the current study 29 (33%) cycles did not record a LH surge, but 22 of these were recorded in the simple ovulation stick sample and it is likely that some participants interpreted the test strips wrongly. Previous research suggests a false-positive rate of 7% using simple ovulation predictor strips (McGovern et al., 2004). This is lower than the current study and it must be acknowledged that the simple strip kits used in the first of the pilot studies are difficult to interpret. The high number of cycles where no LH surge was recorded (45.8%) may be an indication that participants were wrongly interpreting the results. The second pilot study made use of digital ovulation predictor kits which give a digital reading that cleary shows when an LH surge has occurred. In this study the number of cycles where a LH surge was not detected dropped to 17%. This is still a higher number than reported by McGovern et al. (2004), but supports the suggestion that some participants were misinterpreting the results using the simple stick method.

There are a number of reasons why women have anovulatory cycles (ovulation does not take place), ranging from stress (Tarin, Hamatani & Cano, 2010) to Polycystic Ovary Syndrome (PCOS) (Elsedeek & Elmaghraby, 2011), but an anovulatory cycle is often preceded by and or followed by ovulatory cycles (Chatterton *et al*., 2005; Hambridge et al., 2013). Overall 90% of participants ovulated within ± 2 days of the predicted date based on cycle length. Variability between self-reported menstrual cycle length and actual menstrual cycle length is small (see Section 3.7.1), so predicting ovulation based on self-reported cycle length should ensure that testing in the predicted ovulatory phase is carried out when estrogen levels are high. Based on this testing carried out seven days after the predicted day of ovulation, should capture the mid-luteal phase for the majority of participants.

Chapter 4: Do Mood and Well-Being Change Across the Menstrual Cycle?

4.0. Overview

Research examining mood and the menstrual cycle has previously focused on negative symptoms reported by some females in the premenstrual phase of their cycle (Baca-Garcia et al., 2010; Bertone-Johnson et al., 2009; Cunningham et al., 2009; Natale & Alberatazzi, 2006; Wright & Badia, 1999); and increases in positive mood experienced by some females during ovulation (Farage et al., 2008; Shors & Leuner, 2003). These results suggest that negative symptoms in the premenstrual phase may be related to reduced levels of progesterone and estrogen. Positive symptoms in the ovulation phase may be related to peak levels of estrogen combined with increased levels of progesterone. Very little research has considered the influence of peak levels of progesterone in combination with increased levels of estrogen in the mid-luteal phase. Thus, the first aim of this chapter is to measure mood and subjective happiness in three menstrual phases rather than two to examine if changes in mood and subjective happiness are similar or different to those that occur at ovualtion. The second aim is to look at more positive measures of well-being, an under researched area, and examine these across three menstrual cycle phases. There is some evidence to suggest that estrogen influences positive affect (e.g. Farage et al., 2008; Shors & Leuner, 2003) therefore a series of measures will be used to examine possible positive and negative changes across the menstrual cycle. Positive psychology is the scientific examination of positive subjective experiences. Positive psychology examines the factors that contribute to overall happiness including well-being, hope and contentment, and measures the positive individual traits that contribute to happiness (Seligman & Csikszentmihalyi, 2000).

The relationship between positive psychology and the menstrual cycle is under researched, however, mindfulness practices have been shown to be effective in reducing some PMS symptoms (Lustyk et al., 2011). Females who are higher in mindfulness, and more aware of their menstrual cycle (e.g. know cycle length and regularity of cycle), and report less severe symptoms than females with less of a mindful disposition (e.g. unaware of cycle length or regularity of cycle). Increased mindfulness has been found to negatively correlate with premenstrual pain, negative affect and water retention (Lustyk et al.,2011). Due to the fact that so little research exists investigating the relationship between positive traits and the menstrual cycle, the current chapter will investigate this further.

Currently no research reports on the influence of the menstrual cycle on curiosity, however research has reported that risk taking is reduced during ovulation when estrogen is at peak levels and progesterone is increased (Chavanne & Gallup, 1998). Risky behaviour may be driven by a need to satisfy curiosity (Trimpop, 1994) and if risk taking is influenced by the menstrual cycle, it may be that the curiosity driving this change is being influenced by the menstrual cycle. Similarly, research suggests that risky behaviour can be driven by hope (Decharms & Dave, 1965), so it might be suggested that levels of hope will fluctuate over the course of the menstrual cycle. Therefore, the positive measures that will be administered in the current study are the Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003); Curiosity and Exploration Inventory (CEI-II) (Kashdan et al., 2009) and The Trait Hope Scale (Snyder et al., 1991). Traits are relatively stable long-term dispositions that cause individuals to act in a predictable way. Feingold (1994) however, commenting on gender differences in personality traits, argues that expectations about the type of behaviour individuals believe they should display influences how they respond to self-report measures. All measures used in this study are self-report questionnaires and these may indicate that participants perceive changes in their trait related behaviours that can be attributed to menstrual cycle phase.

4.1. Mood and the Menstrual Cycle

Negative mood: Much of the research relating to mood and the menstrual cycle concerns negative mood experienced by some women in the premenstrual phase of their cycle (e.g. Perz & Ussher 2006; Shah, 2013). Negative mood clustered with other symptoms such as breast tenderness or more severe behavioural symptoms such as depression, anger or uncontrolled rage are regarded as evidence of premenstrual syndrome (PMS) (Attieh et al., 2013; Perz & Ussher, 2006; Shah, 2013). Premenstrual syndrome refers to the cluster of symptoms reported by women in the days immediately before the onset of menses which alleviate once menstruation begins (Attieh et al., 2013; Gold et al., 2007). Symptoms tend to vary in type and severity but often include negative mood, and are reported by up to 80% of women in Western societies (Pearlstein & Steiner, 2008).

As stated, much of the research relating to mood and the menstrual cycle is focussed on the premenstrual phase which suggests the involvement of progesterone. Some researchers report that increased progesterone levels lead to increased negative mood (e.g. Eriksson et al., 1992; Halbreich et al., 1986; Hammarback et al., 1989; Redei & Freeman, 1995) while others report that increased progesterone levels reduce negative mood (Bäckström & Carstensen, 1974; Dennerstein et al., 1984; Munday et al., 1981). More recently, Ziomkiewicz et al. (2012) carried out a study with a large sample of females without PMS and reported that decreased progesterone levels were related to higher levels of negative symptoms. They reported a biphasic relationship between progesterone and intensity of PMS symptoms (including aggressive behaviour and fatigue), with low progesterone levels leading to higher intensity of symptoms, but no association between high levels of progesterone and negative symptoms. This large sample study offers strong evidence linking progesterone and PMS symptoms and shows that low levels of progesterone can result in negative symptoms.

In a systematic review of mood and the menstrual cycle Romans, Clarkson, Einstein, Petrovic and Stewart (2012) reported that out of 47 studies (published in English) examining the relationship between mood and the menstrual cycle, 18 of these did not find any relationship between mood and any menstrual cycle phase. Interestingly, only seven studies reported a direct relationship between negative mood and the pre-menstrual phase. Other established relationships with negative mood involved the pre-menstrual phase AND another phase. Thus, there is currently a lack of a clear consensus for an established relationship between negative mood and the pre-menstrual phase.

This study intends to explore responses during the mid-luteal phase of the menstrual cycle rather than the premenstrual phase. In the premenstrual phase, both estrogen and progesterone drop sharply suggesting that reduced levels of these hormones cause to PMS symptoms. In the mid luteal phase progesterone is high and estrogen is beginning to decrease (See Chapter 3 Section 3.5), so testing at this point in the menstrual cycle should allow any change in response to be attributed to high levels of progesterone in combination with higher estrogen (although not peak activity).

Research related to the premenstrual phase of the cycle (see Chapter 3 Section 3.4) is generally carried out two to three days prior to the onset of menses (Oininen & Mazmanian, 2002). However, as stated, testing in the current study will be carried out in the mid-luteal phase. Testing seven to nine days after ovulation, and before the premenstrual phase, should prevent testing occurring when some participants may be experiencing the negative symptoms of PMS. The luteal phase of the menstrual cycle does not fluctuate and is 14 days long (see Chapter 3 Section 3.3), and the premenstrual phase occurs three to five days prior to menstruation. Therefore, testing in the mid-luteal phase will occur several days before the premenstrual phase.

Positive mood: Changes in positive mood have been attributed to estrogen with a relationship shown between positive mood elevation and increased estrogen levels in the ovulatory phase (Farage et al., 2008; Shors & Leuner, 2003). Estrogen has also been shown to alleviate the symptoms of PMS (Epperson et al., 1999) and postpartum depression (Gregoire et al., 1996; Sichel, Cohen, Robertson, Ruttenberg & Rosenbaum, 1995) and can reduce negative affect in post-menopausal women taking HRT (Almeida, 1999; Demetrio et al., 2011; Hogervorst, Boshuisen, Riedel, Willeken & Jolles, 1999). Additionally, general well-being in females is found to be higher in the follicular phase (between menstruation and ovulation) of the menstrual cycle compared to the luteal phase (following ovulation until menstruation) and this suggest a possible link between well-being and estrogen (Brown, 2014). The research suggests a link between high levels of estrogen and positive affect; however, progesterone levels are also raised at ovulation so may also be related to increased positive affect. If progesterone is also related to increased positive affect it might be expected that positive mood and well-being will also be increased in the mid-luteal phase when peak levels of progesterone combine with raised levels of estrogen.

Cheerfulness*:* A person who is regarded as cheerful is thought to smile and laugh easily, be in a cheerful mood, be calm in the face of adverse life circumstances, have a cheerful and interactive style and be amused by a wide range of items that elicit smiling and laughing (Ruch, Köhler & van Thriel, 1997). Trait cheerfulness refers to the *general* disposition of the person while state cheerfulness refers to how the person feels *at that specific moment* (Ruch & Carrell, 1998). Three factors are said to contribute to trait cheerfulness: cheerfulness itself, seriousness and bad mood, both of which reduce any predisposition to exhilaration (Ruch et al., 1997). Cheerfulness negatively correlates with seriousness and bad mood, so if a participant scores highly on the Cheerfulness Scale, they would be expected to have lower scores for bad mood and seriousness and should be more susceptible to smiling and laughing (Ruch et al., 1997). Recent literature reviews (Chapter 1, Figure 1.11) uncovered

no research has been related to cheerfulness and menstrual cycle phase, however given that positive and negative mood fluctuate dependent on menstrual cycle phase it might be expected that participants perceive that their level of cheerfulness also alters over the course of menstrual cycle. As cheerfulness reflects positive affect it might be expected that cheerfulness will be increased at ovulation when estrogen peaks.

***Subjective happiness*:** Research has established that there are several factors contributing to happiness or well-being and these include money, exercise, an individual's goals in life, life events and an individual's own disposition (Costa & McCrae, 1984; Juster & Stafford, 1985; Michalos, 1985; Parducci, 1984; Omodei & Wearing, 1990). Very little research has been carried out examining the effects of the menstrual cycle on well-being or happiness, however, happiness is found to increase when estrogen levels and are high and also when progesterone levels are high (Brown, 2014). Levels of happiness, however, are found to decrease in the premenstrual phase when both estrogen and progesterone levels drop sharply. Females' overall well-being is thought to peak at ovulation with females reporting increased libido and overall emotional well-being and a decrease in mood swings, irritability and lack of concentration when estrogen peaks (Brown, 2014). Again, this suggests a link to the hormonal fluctuations experienced by women across the menstrual cycle and if hormones *do* influence positive mood and this is related to estrogen or progesterone positive mood may alter according to menstrual cycle phase. It is expected that happiness will increase as estrogen peaks at ovulation and that a secondary peak may be evident in the mid-luteal phase when progesterone peaks and estrogen levels are high.

4.2 Well-being and the menstrual cycle

***Mindfulness*:** Mindfulness can be defined as purposefully attending to something in the present and on a moment-to-moment basis with the intention of achieving and accepting a non-judgemental state

of awareness (Kabat-Zinn, 2013). Mindfulness is often achieved through meditation during which an individual becomes aware of their own thought processes (Teasdale et al., 1995). Starting by controlling their breathing, the meditator becomes aware of their thoughts and emotions as well as any physical sensations. Mindfulness exercises can lead to a reduction in stress, anxiety and negative affect (Call, Miron & Orcutt, 2014; Rubia, 2009; Shapiro et al., 2006) and can reduce the severity of some PMS symptoms (Lustyk et al., 2011). For example women with a higher degree of mindfulness will experience fewer sweet and chocolate cravings than women lower in mindfulness (Bowen et al., 2009; Ostafin & Marlatt, 2008) while overall symptom reporting is lower in women who are high in mindfulness (Lustyk et al., 2011). This suggests that high mindfulness may lead to reduced reporting of negative mood changes over the course of the menstrual cycle. Although no research reports on mindfulness and positive mood change across the menstrual cycle, participants who are high in mindfulness may be more open to positive mood changes at ovulation. This may lead to them reporting increases in positive mood and well-being when estrogen peaks in the ovulatory phase.

***Curiosity*:** Curiosity is the desire for new information aroused by things that are novel and that motivates an individual to explore to relieve their uncertainty (Litman, 2005). People high in trait curiosity are thought to attend more readily to things that are novel or challenging and are therefore more likely to explore and engage with such experiences than people lower in trait curiosity (Gallacher & Lopez, 2007). Individuals who are high in curiosity report higher levels of well-being, while a lack of curiosity is thought to lead to an intolerance of uncertainty which can lead to anxiety (Kaczmarek, Baczkowski, Enko, Baran & Theuns, 2014). Curiosity is made up of two factors; 'stretching' which is the motivation an individual has to seek out novel things, and 'embracing' which refers to an individual's willingness to embrace those things in life that are novel or unpredictable (Kashdan et al., 2009). Although curiosity has not been directly examined in relation to the menstrual cycle, previous research has examined hormonal changes across the cycle in relation to reward and motivation (e.g. Diekhof,

2015). For example, Terner and de Wit (2006) reported that women were more responsive to reward-related substances in the late follicular phase. However, they acknowledge that phase definition differs amongst the research included in their review and establishing whether increased or decreased levels of progesterone are involved is problematic. In the current study two aspects of curiosity (stretching and embracing) will be measured in the mid-luteal phase when progesterone is high and combined with raised levels of estrogen to establish whether participants are more motivated in this phase.

***Hope*:** Hope is the perception an individual holds, that goals can be met and is thought to consist of two aspects, agency and pathway (Snyder et al., 1991). Agency refers to goal directed determination while pathway refers to the planning of how an individual means to meet those goals and is positively correlated with positive affect and negatively correlated with negative affect (Snyder et al., 1991). If estrogen and progesterone influence positive and negative affect they may also influence perceptions of hope, so changes may be evident over the course of the menstrual cycle. Hope has been shown to decline over time and the decline has been shown to be faster in females than in males (Heaven & Ciarrochi, 2008) and this again may be suggestive of a link to sex hormones. In this study questionnaire responses will be examined to examine whether both aspects of hope (agency and pathway) alter over the course of three menstrual cycle phases. This evidence suggests that reduced levels of sex hormones may lead to decreased levels of hope so it is expected that increased hormone levels during ovulation and in the mid-luteal phase will lead to an increase in hope.

***Hormonal Contraception and Well-being*:** Hormonal contraceptives can also affect general well-being. For example, females using combined oral contraceptives and females using progesterone only contraceptives have reported reduced general well-being compared to females with natural menstrual cycles (Brown et al., 2008). Additionally, some women using LARC's containing progesterone only compounds have been reported to have an increased likelihood of experiencing the symptoms of depression (Civic et al., 2000; Westhoff, Wieland & Tiezzi, 1995). There is some research suggesting

a link between progesterone levels and negative affect, however, there is disagreement regarding whether increased levels or decreased levels of progesterone are the causal factor (e.g. Redei & Freeman, 1995; Ziomkiewicz et al., 2012). If hormonal contraceptive use does increase the likelihood of experiencing negative moods, it may be that participants with natural menstrual cycles record higher scores on positive measures and lower scores on negative measures than participants using hormonal contraceptives in general.

It might also be expected that although overall scores in hormonal contraceptive users may be lower, scores for these measures will fluctuate less in females using contraceptives than in females with natural cycles since they do not experience the same changes in hormone levels across the menstrual cycle as naturally cycling females (see Chapter 1 Figure 1.9). However, it should be noted that the hormonal contraceptive users are treated here as a homogenous group although different types and generations of contraceptives were being taken by females in this group. Insufficient numbers of participants knew which generation and which type of hormonal contraceptive they were taking to allow for testing within this group.

Current study: Participants will be asked to complete a series of mood related questionnaires (State and Trait Cheerfulness Inventory (STCI) and the Subjective Happiness Scale (SHS)) as well as a series of positive psychological measures related to well-being (Mindfulness Awareness Scale (MAS), Trait Hope Scale, Curiosity scale)). Previous research suggests that high levels of estrogen are related to an increase in positive affect (e.g. Farage et al., 2008), so it might be expected that participant responses will show higher levels of well-being and positive mood when estrogen levels are high at ovulation and again in the mid-luteal phase when they combine with high levels of progesterone. Participants will be asked to complete the questionnaires in the menstrual, ovulatory and mid-luteal phases of their menstrual cycle and the order in which they complete these will be counterbalanced across the cycle phases.

Predictions: Based on previous research (e.g. Farage et al., 2008; Ziomkiewicz et al., 2012), it is predicted that both positive (Cheerfulness and Subjective Happiness) and negative mood (Seriousness and Bad mood) will fluctuate across the course of the menstrual cycle. Positive mood is expected to increase during ovulation while bad mood is expected to decrease in the same phase. Increased levels of progesterone in combination with estrogen in the mid-luteal phase may also lead to increased positive mood and decreased negative mood. It is also predicted that hormonal contraceptive users will differ in measures of both positive (Cheerfulness and Subjective Happiness) and negative mood (Seriousness and Bad mood) compared to those with natural cycles. Hormonal contraceptive users are not expected to experience mood fluctuations over their cycle so naturally cycling females should report higher levels of positive mood and lower levels of negative mood than hormonal contraceptive user at ovulation and in the mid luteal-phase. It is also predicted that well-being scores (Mindfulness, Curiosity and Hope) will differ over the course of the menstrual cycle and will differ between hormonal contraceptive users and naturally cycling females. More specifically, it is predicted that negative mood scores will be higher in the menstrual phase when all hormone levels are low, than in the ovulatory and mid-luteal phases when estrogen and progesterone are high. It is also predicted that positive mood scores will be lower in the menstrual phase than in the ovulatory and mid-luteal phases. It is also predicted that there will be a negative correlation between cheerfulness and bad mood scores irrespective of phase or contraceptive use as increased estrogen and increased progesterone increase positive mood and reduce negative mood. It is predicted that participants will produce higher mindfulness scores and hope scores in the ovulatory and mid-luteal phases when estrogen and progesterone are at increased levels than in the menstrual phase when both hormones are at their lowest levels. Additionally naturally cycling females will produce higher mindfulness scores, and hope scores during hormonal peak phases than hormonal contraceptive users, who do not experience hormonal fluctuations across their cycle.

4.3. Method

***Participants*:** 46 females using hormonal contraceptives and 40 naturally cycling females (Mean age = 27.7 years) were recruited for this study from Abertay University and via the Online Psychology Research website (www.onlinepsychresearch.co.uk). Participant attrition meant that 23% of participants who agreed to take part in the study did not take part. Of the participants who did take part not all completed all three test phases. (See Figure 5.1). A priori power analysis indicated that to achieve power of .8 and a small effect size (.25) a total sample size of 34 was required.

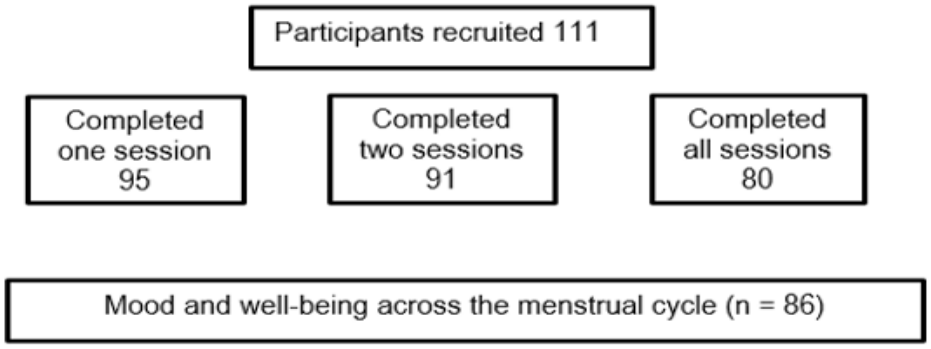


Figure 4.1 Flow chart detailing participant attrition and participants completing one, two or all sessions

***Materials*:** Questionnaires were prepared and presented online using Google Forms. Participants were presented with information about the study (Appendix 4.1), and if they agreed to participate they were asked to complete the consent section (those choosing not to continue were taken to a debrief page and thanked for their time). The online document firstly asked participants to complete demographic information (Appendix 4.1). Participants were asked to provide their age and create an identifier number using their date of birth and initials so that their three sets of completed questionnaire responses could be matched. Participants were also asked to give information about their menstrual cycle length and contraceptive use. A series of questionnaires were then administered.

Mood Questionnaires (see Appendix 4)

***State Trait Cheerfulness Inventory (STCI-S) (Ruch, Kohler & van Thriel, 1997)*:** The Short State Cheerfulness Scale (STCI –S <18>) from the State Trait Cheerfulness Inventory (see Appendix 4.2) consists of 18 statements. Examples include 'I could laugh at the drop of a hat' and 'I am delighted' which participants answer on a four-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Participants are asked to consider their current mood and mental state when answering statements. Three traits make up this scale; they are cheerfulness, seriousness and bad mood and a higher score indicates a higher level of each trait. Seriousness and bad mood will be considered in this study as measures of negative mood. The STCI-S<18> is not widely published so no reliability statistics are available, however, Ruch, et al. (1997), while constructing the short versions of the scale the STCI-S 30 report Cronbach's alphas ranging from .85 - .94.

Subjective Happiness Scale (Lyubomirsky & Lepper, 1999): The Subjective Happiness Scale consists of four statements that participants are asked to rate on a seven-point Likert scale (see Appendix 5.3). The first statement is related to how happy the respondent considers themselves to be with responses ranging from 'not a very happy person' to 'a very happy person'. The second statement asks about personal happiness in comparison to others and responses range from 'less happy' to 'more happy'. The final two questions describe how other people feel and ask the participant how well the description fits them ("some people are generally very happy…' and 'some people are generally not very happy….') with responses ranging from 'not at all' to 'a great deal'. A higher overall score on the questionnaire indicates a higher level happiness. Lyubomirsky and Lepper (1999) report the Cronbach's alpha of this scale to be .86.

Well-being questionnaires.

Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003): MAAS (see Appendix 4.4) was designed to focus on the attentional aspects of mindfulness. MAAS consists of 15 statements such as 'I could be experiencing some emotion and not be conscious of it until sometime later' which participants are asked to respond to using a six-point Likert scale ranging from 'almost always' to 'almost never'. Participants are asked to consider their actual experience rather than what they feel the appropriate experience should be when answering. A higher score is an indication of greater mindfulness. Internal consistency levels (Cronbach's alphas) of this scale range from .80 to .90 (Brown & Ryan, 2003).

Curiosity and Exploration Inventory (CEI-II) (Kashdan et al., 2009): The Curiosity and Exploration Inventory (see Appendix 5.5) was designed to measure curiosity and consists of ten statements such as 'I actively seek as much information as I can in new situations' and 'Everywhere I go; I am out looking for new things or experiences'. Statements are answered on a five-point Likert scale ranging from 'very slightly or not at all' to 'extremely' to show how accurately they reflect the respondent's general feelings and behaviour. Two scales (stretching and embracing) are calculated and a higher score indicates a higher level of curiosity. Internal reliability is satisfactory with Cronbach's alpha ranging from .58 - .72 (Cavojová & Sollár, 2007)

The Trait Hope Scale (Snyder et al., 1991): Hope is believed to be related to goal driven behaviour with those who are hopeful having things they want to achieve and believing that they can achieve them. This scale (see Appendix 5.6) consists of 12 statements and measures two scales related to goal driven behaviour (agency) and planning required to achieve those goals (pathway). Statements include items such as 'I can think of many ways to get out of a jam' and 'I meet the goals that I set for

myself'. Statements are scored on an eight-point Likert scale ranging from 'definitely false' to 'definitely true'. Participants are invited to state how each statement describes them and a higher score indicates higher hopefulness. Snyder et al. (1991) calculated reliability statistics over a number of testing sessions during the development of the Trait Hope Scale and found the median Cronbach's alpha value of the overall scale to be .93. The median Cronbach's alpha value for both the agency and pathways sub-scales was .91.

Procedure: Once recruited, participants were asked about the day and length of their menstrual cycle. Based on this information, the dates which they should complete the questionnaires on were calculated and this information was passed on to each participant (see Chapter 3 Section 3.5.1). The order of this was counterbalanced, with participants completing the questionnaires for the first time based on where they currently were in their cycle e.g. a participant who had just finished menstruating would be tested for the first time in the ovulatory phase, then in the mid-luteal phase with the menstrual phase being the final test session. Participants in the middle of their cycle were tested for the first time in the mid-luteal phase then the menstrual phase with the final test session taking place in the ovulatory phase. Participants at the end of their cycle were tested for the first time during menstruation the second time at ovulation and the final time in the mid-luteal phase. Questionnaires were completed in the same order by all participants, however, responses were sorted by order of testing and analysed by test session and no order effects were found (see appendix 4.7). Before each testing date an email containing a direct link to the questionnaires was sent to remind participants to complete the questionnaires. On the first test date participants completed a short demographic questionnaire prior to completing the questionnaires providing information about their age, contraceptive use, menstrual cycle length and contraceptive use were recorded. Participants created an identifying number using their date of birth and initials and this was used to match their responses over the three test sessions. The ID was removed after responses were matched. Once participants had completed, and submitted,

the questionnaire for the final time they were automatically taken to a page thanking them for participating and providing a debrief to the study.

4.4. Results

***Mood across the menstrual cycle*:**

State Trait Cheerfulness Inventory (STCI 18): Participants (n = 86; 46 hormonal contraceptive users and 40 naturally cycling females) completed the State Trait cheerfulness questionnaire in three menstrual cycle phases (see Chapter 3 Section 3.2.5). The measure has three scales: Cheerfulness, Seriousness and Bad Mood. Relationships between the scales are shown in table 4.1

Table 4.1

Correlations between cheerfulness and seriousness and cheerfulness and bad mood in three menstrual cycle phases.

Menstrual Cycle Phase		Trait		
Menstrual		Cheerfulness	Seriousness	Bad Mood
	Cheerfulness	1	-.115	-.544*
	Seriousness	-.115	1	.17
	Bad Mood	-.544*	.17	1
Ovulatory				
	Cheerfulness	1	-.038	-.515*
	Seriousness	-.038	1	.16
	Bad Mood	-.515*	.16	1
Mid-Luteal				
	Cheerfulness	1	.095	-.703*
	Seriousness	.095	1	.097
	Bad Mood	-.703*	.097	1

*Significant at the 1% level

Table 4.1 shows that cheerfulness and bad mood were negatively correlated in all three menstrual cycle phases. Data were normally distributed so correlations were examined using Pearson's correlation coefficient, which revealed no significant, correlations between cheerfulness scores and seriousness scores, or between seriousness and bad mood in any of the menstrual cycle phases. However, in keeping with previous research (e.g. Ruch et al., 1997) cheerfulness scores decreased

as bad mood scores increased and this correlation was significant in all three menstrual cycle phases (menstrual r = -.54, p <.001; ovulation r = -.52, p <.001; mid luteal r = -.7, p <.001)

***Menstrual cycle phase and contraceptive use effects*:** The data were then examined for any differences in cheerfulness, seriousness and bad mood scores as well as subjective happiness scores, between naturally cycling females and hormonal contraceptive users.

Table 4.2
Mean scores for cheerfulness, seriousness, bad mood and subjective happiness in three MC phases for hormonal contraceptive users and naturally cycling females.

	Hormonal Contraceptive Users	Naturally Cycling Females
Positive mood		
Cheerfulness		
Menstrual	15.15 (3.5)	15.09 (3.9)
Ovulation	16.06 (3.4)	14.93 (4.2)
Mid Luteal	15.03 (4.2)	15.63 (4.2)
Subjective Happiness		
Menstrual	17.76 (3.1)	16.94 (3.2)
Ovulation	17.15 (3.7)	16.48 (3.4)
Mid Luteal	17.79 (2.8)	16.74 (3.4)
Negative mood		
Seriousness		
Menstrual	17.36 (3.1)	17.46 (3.1)
Ovulation	17.62 (2.9)	18.04 (3.2)
Mid Luteal	17 (3.7)	17.26 (2.5)
Bad Mood		
Menstrual	11.7 (4.9)	10.71 (4.1)
Ovulation	10.74 (4.4)	10.11 (4.7)
Mid Luteal	10.48 (5.4)	10.11 (4.6)

***Cheerfulness, seriousness and bad mood*:** Table 4.2 shows that cheerfulness scores, seriousness scores and bad mood scores varied only slightly over the menstrual cycle phases for both hormonal cycle users and naturally cycling females and did not differ greatly between the groups.

Using MANOVA there were no significant effects of contraceptive use on cheerfulness scores, seriousness scores and bad mood scores ($p = .46$). There were also no significant effects of menstrual cycle phase on cheerfulness scores, seriousness scores and bad mood scores ($p = .83$) nor was there a significant interaction between contraceptive use and menstrual cycle phase on cheerfulness scores, seriousness scores and bad mood scores ($p = .84$). There were no significant univariate effects (all p's $> .05$).

***Power analysis*:** Power calculations carried out using G*Power for MANOVA with two groups and three within subjects dependent variables (9 comparisons) indicated that to achieve Power of .8 for a small effect size (.25) a total of 24 participants were required. A total of 86 participants were included in this analysis suggesting the study had sufficient power to detect an effect. This was confirmed with a post hoc power analysis using G*Power for three groups and nine comparisons (3 dependent variables) achieving power of 1.

Subjective Happiness Scale: Table 4.2 shows that subjective happiness scores differed very little over the course of the menstrual cycle with both hormonal contraceptive users and naturally cycling females having similar scores. Data for both participant groups failed to meet parametric assumptions so were analysed using non-parametric tests.

Mann Whitney U tests revealed no significant differences in subjective happiness scores between hormonal contraceptive users and naturally cycling females in the menstrual phase ($p = .18$), the ovulatory phase ($p = .43$) or in the mid-luteal phase ($p = .41$). A Friedman test was carried out on all participant data to examine differences in overall subjective happiness scores between the menstrual cycle phases and found no significant difference ($p = .86$). Data were then split by contraceptive use to examine differences in subjective happiness scores between the menstrual cycle phases for the

individual groups. Friedman test were carried out and found no significant difference for hormonal contraceptive users (p = .7) or for naturally cycling females (p = .99).

Measures of Well-being: As well as completing measures of mood, participants completed a series of measurements of well-being (mindfulness, curiosity and hope). Participants completed each questionnaire three times, once in the menstrual phase, one in the ovulatory phase and once in the mid-luteal phase. Data for Mindfulness, Curiosity and Hope, met parametric assumptions (normal distribution and homogeneity of variance) and were analysed using 2 (contraceptive use) x 3 (menstrual cycle phase) mixed ANOVA. Significant menstrual cycle phase effects were followed up using Bonferroni tests. Mean scores with standard deviations are presented in table 4.3

Table 4.3.
Mean scores for Mindfulness, Curiosity and Hope for hormonal contraceptive users and naturally cycling females over three menstrual cycle phases

	Hormonal Contraceptive Users	Naturally Cycling Females
Mindfulness		
Menstrual	3.59 (.78)	3.85 (.84)
Ovulation	3.43 (.99)	3.83 (.8)
Mid Luteal	3.85 (.71)	3.94 (.97)
Curiosity (Stretching)		
Menstrual	17.44 (3.9)	18.37 (4.2)
Ovulation	17.56 (4)	17 (3.7)
Mid Luteal	18 (3.7)	17.69 (4.1)
Curiosity (Embracing)		
Menstrual	14.69 (4.4)	15.26 (4.8)
Ovulation	15.56 (4.1)	13.52 (4.8)
Mid Luteal	16.03 (3.6)	14.62 (4.4)
Hope (Agency)		
Menstrual	23.44 (3.4)	25.03 (4.98)
Ovulation	24.15 (4.2)	23.89 (4.9)
Mid Luteal	23.25 (3.4)	23.15 (4.6)
Hope (Pathway)		
Menstrual	22.44 (3.9)	24 (3.8)
Ovulation	23.53 (4.2)	22.70 (3.7)
Mid Luteal	23.87 (4.1)	23.31 (4.6)

Mindfulness: Table 4.3 shows small differences in mindfulness scores across the menstrual cycle phases for both hormonal contraceptive users and naturally cycling females with both groups recording higher mindfulness scores in the mid-luteal phase than in the menstrual and ovulatory phases.

A 3 (cycle phase) x 2 (contraceptive use) mixed ANOVA revealed a significant main effect of menstrual cycle phase on mindfulness scores [$F (2, 82) = 3.83$, $p = .026$] small effect $\eta p^2 = .1$ observed power $\beta = 7$. There was no significant effect of contraceptive use on mindfulness scores ($p = .85$), nor was there a significant interaction between menstrual cycle phase and contraceptive use ($p = .83$). The significant menstrual cycle phase effect was followed up using Bonferroni tests. A significant difference between the menstrual and mid-luteal phase ($p = .035$) small effect ($d = .2$), however, no significant difference was found between the menstrual and ovulatory phases ($p = .1$) or between the ovulatory and mid-luteal phases ($p = .07$).

Curiosity (Stretching): Table 5.3 shows that hormonal contraceptive users and naturally cycling females scored similarly across the menstrual cycle phases. Highest Curiosity (stretching) scores were in the mid-luteal phase for hormonal contraceptive users, while naturally cycling females recorded their highest scores in the menstrual phase.

A 3 (cycle phase) x 2 (contraceptive use) mixed ANOVA revealed a significant main effect of menstrual cycle phase on Curiosity (Stretching) scores [$F (2, 84) = 4.86$, $p = .01$], small effect $\eta p^2 = .1$, observed power $\beta = .8$. There was no significant main effect of contraceptive use on curiosity (stretching) scores ($p = .81$), nor was there a significant interaction between menstrual cycle phase and contraceptive use ($p = .075$). Significant menstrual cycle phase effects were analysed further using post hoc Bonferroni tests. Scores were significantly higher in the menstrual than in the ovulatory phase ($p = .014$, small effect $d = .3$). No significant difference was found between the menstrual and mid-luteal phases ($p = .92$) or between the ovulatory and mid-luteal phases ($p = .14$).

Curiosity (Embracing): Table 5.3 shows that curiosity (embracing) scores differed marginally across the menstrual cycle phases. Naturally cycling females recorded higher scores in the menstrual phase than in the ovulatory or mid-luteal phases. However, curiosity (embracing) scores were lowest during the menstrual phase for those in the hormonal contraceptive group.

A 3 (cycle phase) x 2 (contraceptive use) mixed ANOVA revealed no significant effect of menstrual cycle phase on curiosity (embracing) scores ($p = .39$). There was no significant effect of contraceptive use on curiosity (embracing) scores ($p = .4$). There was a significant menstrual cycle phase x contraceptive use interaction on curiosity (embracing) scores [$F (2, 84) = 5.84$, $p = .004$], small effect $\eta p^2 = .1$, observed power $\beta = .9$.

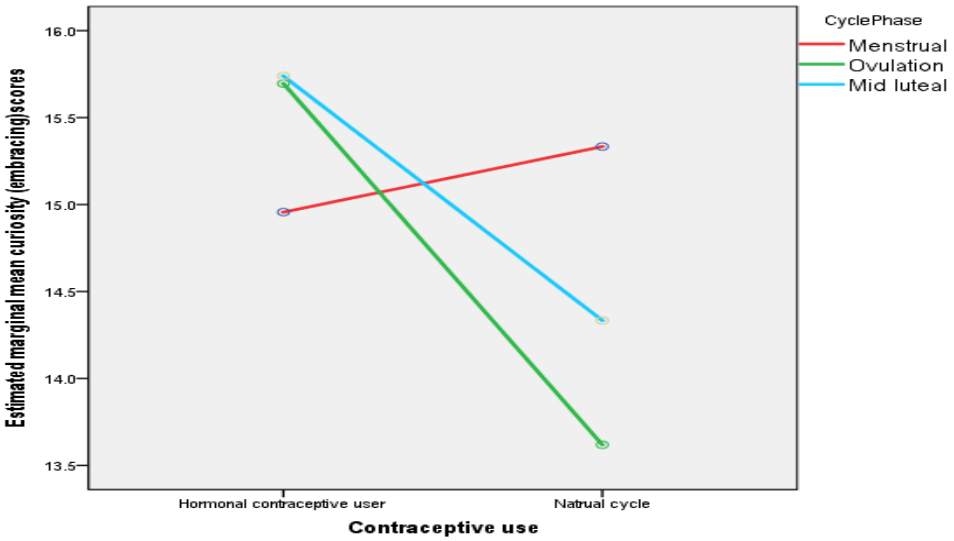


Figure 4.9 Mean curiosity (embracing) scores for hormonal contraceptive users and naturally cycling females in three menstrual cycle phases.

Figure 4.9 shows that hormonal contraceptive users recorded their lowest curiosity (embracing) scores in the menstrual phase with higher scores recorded in the ovulatory and mid-luteal phases. Naturally cycling females recorded their lowest score in the ovulatory phase and their highest scores were recorded in the menstrual phase.

The significant interaction was followed up using 1 x 3 within subjects ANOVA's and revealed that for hormonal contraceptive users there was no significant effect of menstrual cycle phase on curiosity (embracing) scores ($p = .12$). For naturally cycling females, menstrual cycle phase had a significant effect on curiosity (embracing) scores: [$F (2, 40) = 3.75$, $p = .032$], small effect $\eta p^2 = .2$, observed power $\beta = .7$. Pairwise comparisons were conducted using Bonferroni tests and revealed that, for naturally cycling females, curiosity (embracing) scores were significantly higher in the menstrual phase than in the ovulatory phase ($p = .048$, $d = .4$). There was no significant difference in curiosity (embracing) scores between the menstrual and mid-luteal phase ($p = .33$) or between the ovulatory and mid-luteal phase ($p = .82$).

Independent samples t-tests were carried out to compare curiosity (embracing) scores between hormonal contraceptive users and naturally cycling females in each menstrual cycle phase. There were no significant differences between the two groups in the menstrual phase ($p = .69$), the ovulatory phase ($p = .07$) or in the mid-luteal phase ($p = .18$)

***Hope Agency*:** Table 4.3 shows that Hope (Agency) scores are similar across the menstrual cycle phases for hormonal contraceptive users and for naturally cycling females. Agency scores are highest in the mid-luteal phase for the hormonal contraceptive users, and are highest in the menstrual phase for naturally cycling females.

A 3 (cycle phase) x 2 (contraceptive use) mixed ANOVA revealed a significant main effect of menstrual cycle phase on Hope (Agency) scores [$F (2, 84) = 3.13$, $p = .049$], small effect $\eta p^2 = .1$, observed power $\beta = .6$. There was no significant effect of contraceptive use ($p = .99$). There was a significant cycle phase by contraceptive use interaction on Hope (Agency) scores [$F (2, 84) = 3.97$, $p = .022$], small effect $\eta p^2 = .1$, observed power $\beta = .7$. Significant menstrual cycle phase effects were followed up using post hoc Bonferroni tests. There were no significant differences between the menstrual and

ovulatory phase (p = 1); the menstrual and mid-luteal phases (p = .11); or between the ovulatory and mid-luteal phases (p = .09).

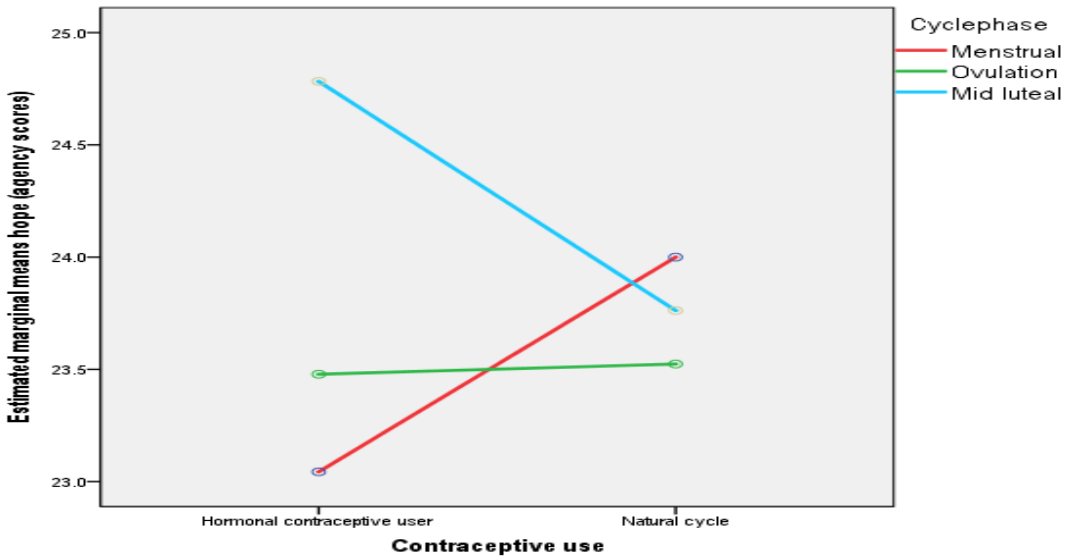


Figure 4.11 Mean Hope (Agency) scores for hormonal contraceptive users and naturally cycling females across the three menstrual cycle phases

Figure 4.11 shows that hormonal contraceptive users recorded their highest Hope (Agency) scores in the mid-luteal phase with lower scores recorded in the ovulatory and menstrual phases. Naturally cycling females recorded their highest hope (agency) scores in the menstrual phase with lower scores recorded in the mid-luteal and ovulatory phases.

The significant interaction was followed up using 1 x 3 within subjects ANOVA's and revealed that, for hormonal contraceptive users, there was a significant effect of menstrual cycle phase on Hope (Agency) scores [$F(2, 44) = 6.1$, $p = .005$], small effect $\eta p^2 = .2$, observed power $\beta = .9$. Pairwise comparisons using Bonferroni tests revealed that Hope (Agency) scores were significantly higher in the mid-luteal phase than in the menstrual phase ($p = .01$, $d = .5$). However, there was no significant difference between the mid-luteal phase and the ovulatory phase ($p = .055$) or between the menstrual

and ovulatory phase (p = 1). For naturally cycling females, menstrual cycle phase had no significant effect on Hope (Agency) scores (p = .59).

Independent samples t-tests were carried out to compare Hope (Agency) scores between hormonal contraceptive users and naturally cycling females and found no significant differences in the menstrual phase (p = .24), the ovulatory phase (p = .78) or in the mid-luteal phase (p = .07)

***Hope Pathway*:** showed no significant effect of menstrual cycle phase (p = .13), contraceptive use (p = .97) nor did cycle phase and contraceptive use interact significantly (p = .14).

***Power Analysis*:** Data for 86 participants was included in the post hoc Power analysis in G*Power which indicated that 86 participants in a study with two groups and nine comparisons achieved power of 1. This suggests that tests carried out on Mindfulness scores, Curiosity (stretching), Curiosity (embracing), Hope (Agency) and Hope (Pathway) were sufficiently powered to detect any effects.

Summary of Chapter 4 findings

***Cheerfulness*:** Overall, cheerfulness correlated negatively with bad mood scores. The negative relationship between cheerfulness and bad mood scores was reported in each cycle phase. There was no difference between menstrual cycle phases on cheerfulness, seriousness or bad mood scores.

***Subjective Happiness*:** No significant differences in subjective happiness scores was found between naturally cycling females and hormonal contraceptive users, nor were there menstrual cycle phase effects or interactional effects.

Measures of Well-being

***Mindfulness*:** Mindfulness scores were significantly lower in the menstrual phase than in the mid-luteal phase.

***Curiosity*:** Curiosity (Stretching) scores were significantly higher in the menstrual phase than the ovulatory phase.

There was a significant menstrual cycle phase by contraceptive use interaction on curiosity (embracing) scores. Cycle phase influenced the Curiosity (Embracing) scores in the naturally cycling females, with scores higher in the menstrual phase than the ovulatory phase.

***Trait Hope*:** There was a significant effect of cycle phase on Hope (Agency) scores. There was also a significant menstrual cycle phase x contraceptive use interaction. Hormonal contraceptive users had significantly higher Hope (Agency) scores in the mid-luteal phase than in the menstrual phase and significantly higher scores in the mid –luteal phase than the ovulation phase. There were no natural cycle effects.

Although no significant contraceptive effects were found in relation to mood and well-being, the groups differed in how menstrual cycle phase influenced curiosity and hope. Curiosity (Embracing) scores differed significantly across the menstrual cycle but no significant differences were found for hormonal contraceptive users. Hope (Agency) scores differed significantly across the menstrual cycle for hormonal contraceptive users, but no significant differences were found across the cycle for naturally cycling females.

4.5 Discussion

Measures of Mood. It was predicted that negative mood scores (Seriousness and Bad mood) would be higher in the menstrual phase when estrogen and progesterone are at their lowest, than in the ovulatory and mid-luteal phases when these hormones are at increased levels. This hypothesis was not supported. It was also predicted that positive mood scores (Cheerfulness and Subjective Happiness) would be lower in the menstrual phase than in the ovulatory and mid-luteal phases and again this hypothesis was not supported.

Contraceptive use was predicted to have an effect on positive mood scores with naturally cycling females expected to record higher scores than hormonal contraceptive users in relation to increased hormone levels. This hypothesis was rejected. Similarly, contraceptive use was predicted to have an effect on negative mood scores with naturally cycling females expected to record higher scores that hormonal contraceptive users when estrogen and progesterone were at increased levels. This hypothesis was also rejected. Previous research has suggested an association between progesterone and negative mood with increased negative mood found when progesterone levels are high (Eriksson et al., 1992; Halbreich et al., 1986; Hammarback et al.,1989; Redei & Freeman, 1995), however, others have reported a reduction in negative mood when progesterone levels are high (Dennerstein et al., 1984; Munday et al., 1981). This study found no significant differences in positive or negative mood scores between the menstrual cycle phases.

Previous research has reported that both positive and negative mood fluctuate over the course of the menstrual cycle with positive mood shown to increase at ovulation and decrease in the premenstrual phase (Cockerill, Wormington & Nevill, 1994). In the current study, no significant menstrual cycle phase changes were recorded. Some researchers (e.g. Assoc & Magos, 1992), have reported that

negative mood decreases at ovulation and increases during the premenstrual phase, while others have failed to find any changes in mood over the course of the menstrual cycle (e.g. Compton & Levine, 1997). In the current study, no testing took place in the premenstrual phase so results cannot be directly compared with others who have reported decreases in mood here. In the current study, testing was carried out in the mid-luteal phase when progesterone levels are at their highest and estrogen levels are beginning to drop.

One aim of the study was to examine the role of high levels of progesterone in combination with elevated estrogen levels on mood rather than testing in the premenstrual phase when hormone levels are low (see Chapter 3 Section 3.5). Changes in mood have often been causally linked to hormones, with estrogen often being related to positive mood elevation and reduced progesterone linked to increased negative mood (Farage et al., 2008; Shors & Leuner, 2003). In the current study, the expected increase in positive mood at ovulation was not evident in either of the groups and it may be that fluctuating hormones alone are not sufficient to drive change in mood. It is feasible that testing for some participants took place before or after the peak estrogen surge. Estimated day of ovulation was based on menstrual cycle length and it is feasible that not all participants were tested during the peak estrogen phase (see Chapter 3 Section 3.5).

It was predicted that there would be a negative correlation between cheerfulness and bad mood scores (using the State Trait Cheerfulness Inventory), and this hypothesis was supported. When data were examined overall cheerfulness scores decreased as bad mood scores increased. This supports previous research which suggests that if a participant scores highly on the cheerfulness scale, they would be expected to have lower scores for bad mood and seriousness and should be more susceptible to smiling and laughing (Ruch et al., 1997). Trait cheerfulness refers to the general disposition of the person while state cheerfulness refers to how the person feels at that specific

moment (Ruch & Carrell, 1998). To the researcher's knowledge, no previous research has been reported examining cheerfulness across the menstrual cycle, therefore, additional analysis was carried out examining these relationships. Analyses revealed that the negative relationship between cheerfulness and bad mood did not alter over the course of the menstrual cycle but was strongest in the mid luteal phase. This may reflect a more intense experience of these traits, or may simply indicate that the perception of these is stronger in the mid-luteal phase.

Contraceptive use was predicted to have an effect on cheerfulness, seriousness and bad mood scores, however, these hypotheses were not supported. Hormonal contraceptive users and naturally cycling females recorded similar scores in all measurements. It was also expected that menstrual cycle phase would have an effect on seriousness and bad mood scores and these hypotheses were not supported, participants showed only marginal changes in scores across the menstrual cycle phases.

These results may indicate that the groups do not differ in terms of mood, or may be attributable to the variety of contraceptive methods used by females in the hormonal contraceptive user group. Type of contraceptive (containing drospirenone or desogesterel) (See Chapter 1 Section 1.6) is a factor that needs to be examined in more depth using larger samples to establish if hormonal content can influence mood and well-being. It may be that the mood of participants using combined oral contraceptives (COC's) differs from that of participants taking progesterone only contraceptives (POP's). Some COC's are biphasic or triphasic delivering different levels of hormone across the menstrual cycle. This mimics a natural menstrual cycle which means that for these women estrogen and progesterone levels rise and fall over the course of the cycle. POP's release progesterone at a consistently low level over the menstrual cycle. It is not unreasonable to suggest that the experiences of these groups will differ. In this study, hormonal contraceptive users were treated as a homogenous group and it may be that performance within this group differed according to type and/or generation of

hormonal contraceptive. Different generations of contraceptive pills contain different amounts of, and different types of progestins and this has been shown to influence how females perform on some cognitive tasks (Batur, Elder & Mayer, 2003; Griksiene & Ruksenas, 2011). It therefore seems reasonable to suggest that mood might also be influenced differently for females using different types of hormonal contraceptives and this would not have been picked up in the current analyses.

***Measures of Well-Being*:** It was predicted that participants would produce higher Mindfulness and hope scores in the ovulatory and mid-luteal phases than in the menstrual phase. It was also predicted that naturally cycling females would produce higher Mindfulness scores and Hope scores than hormonal contraceptive users. In relation to Mindfulness, it was found that mindfulness scores were significantly higher in the mid-luteal phase than in the menstrual phase, with no difference in scores occurring between the menstrual and ovulatory phase. Previous research reports that females who are higher in mindfulness are more aware of their menstrual cycle and this leads to them reporting less severe symptoms of PMS than females with less of a mindfulness disposition (Bowen et al., 2009). These women are likely to be more aware of physical and psychological changes in themselves over the course of their cycle which may make them more accepting or tolerant of such change. Increased mindfulness has also been found to negatively correlate with premenstrual pain, negative affect and water retention (Lustyk et al., 2011). It may be that in the mid-luteal phase participants are higher in mindfulness as they monitor their body in the days prior to menstruation (Ostafin & Marlatt, 2008). It can also be proposed that females do become more mindful of their menstrual cycle when waiting for menstruation, particularly if they are concerned about pregnancy (See Chapter 2 Section 2.9).

In relation to curiosity, a significant effect of menstrual cycle phase was found for curiosity (stretching). Curiosity stretching is motivation to seek out novel things (Kashdan et al., 2009). These results suggest that the motivation to seek out new experiences is significantly stronger in the menstrual

phase than in at ovulation. Perhaps, in those seeking to avoid pregnancy, confirmation that this has not taken place provides impetus to seek out new experiences. No significant differences were found between hormonal contraceptive users and naturally cycling females for curiosity stretching which suggests that both groups of females are similar in the drive for novelty.

No significant menstrual cycle phase effect was found for curiosity (embracing), nor did hormonal contraceptive users differ from naturally cycling females. This suggests that estrogen and progesterone do not directly influence these factors. Menstrual cycle phase and contraceptive use interacted to have a significant effect on curiosity (embracing) scores with naturally cycling females recording significantly higher scores in the menstrual phase (all hormones at low levels) compared to the ovulatory phase (estrogen at peak levels and progesterone levels raised). Curiosity (embracing) refers to an individual's willingness to embrace those novel or unpredictable things (Kashdan et al., 2009). These results suggest that in addition to being more motivated to seek out novel things in the menstrual phase, naturally cycling females are also more willing to embrace them. During menstruation, there is very little risk of pregnancy, so perhaps females are more inclined to take more risks in this phase than at ovulation when the risk of pregnancy is at its highest. Similarly, in the mid luteal phase, curiosity may be reduced as a woman protects a potential pregnancy. It might be speculated that hormonal contraceptives diminish these feelings, although further testing should be carried to examine this in more depth. As previously discussed, some hormonal contraceptives ensure hormones remain at consistent levels over the menstrual cycle. Naturally cycling females experience a sharp drop in estrogen and progesterone in the menstrual phase and it may be this that is driving the changes in their behaviour. Additional testing comparing hormonal contraceptive users based on type and/or generation of hormonal contraceptive may also reveal differences between these groups.

A menstrual cycle phase main effect was found in relation to hope (agency scores) but this failed to reach significance when followed up. There was a significant menstrual cycle phase by contraceptive use interaction for hope (agency) scores. When followed up, it was found that for hormonal contraceptive users, hope (agency) scores were significantly higher in the mid-luteal phase (peak levels of progesterone combined with high levels of estrogen) than in the menstrual phase (estrogen and progesterone at lowest levels). Hope refers to the perception an individual has that goals can be achieved and agency refers to goal directed determination (Snyder et al., 1991). These results suggest that hormonal contraceptive users are more driven to meet their goals in the mid-luteal phase of their cycle than in the menstrual phase. However, these results should be treated with some caution as not all participants were using the same type or generation of hormonal contraceptive. It might be speculated, however, that the higher levels of progesterone combined with increased levels of estrogen in the mid-luteal phase experienced by naturally cycling females is suppressing this drive. It is interesting, however, that naturally cycling women become more driven to seek out novel experiences once their progesterone levels drop and menstruation begins. These findings are suggestive of links between progesterone levels and hope and curiosity.

4.6 Conclusion

The aim of this study was to explore the influence of sex hormones (estrogen and progesterone individually and in combination) on measures of mood and well-being. The intention was to investigate if responses to these (trait) measurements would be influenced by menstrual cycle phase. Previous research examining mood has tended to focus on the negative premenstrual changes reported by some females, however, this study intended to explore responses (positive or negative) during the mid-luteal phase of the menstrual cycle rather than the premenstrual phase. Testing in this phase when progesterone is at its highest level and combined with high estrogen levels (See Chapter 3 Section 3.5) should allow any change in response to be attributed to progesterone in combination with

estrogen. Results from this study suggest that hormonal fluctuations do not significantly influence positive or negative mood in females.

Results suggest that some aspects of well-being may be influenced by hormonal fluctuations across the menstrual cycle, with women being higher in mindfulness in the mid-luteal phase of their cycle than during menstruation. This may simply be that women are more aware of changes in their body during this phase than at other stages of the menstrual cycle. As previously suggested this may be linked to potential pregnancy, however, it is unclear why hormonal contraceptive users would be more mindful if this were the cause. Hormonal contraceptive users who still experience menstruation will know when to expect their menses based on the number of pills they have taken over a 28 day period and will be anticipating this to occur. This may be why they are more mindful in this phase than at others. A closer examination of the type of hormonal contraceptive being used would provide more insight. Different generations of hormonal contraceptives contain different types and levels of progesterone and estrogen (see Chapter 1 Section 1.5) and it is feasible that type or generation of hormonal contraceptive influences mindfulness. It may be that the combination of high levels of progesterone and estrogen in the mid-luteal phase increase mindfulness but further testing is required to explore this further. Some hormonal contraceptives contain only progesterone so further study with these participants might help establish the role of progesterone on mindfulness.

Curiosity was also found to fluctuate over the course of the menstrual cycle in both groups of females with all females scoring significantly higher in curiosity in the menstrual phase of their cycles. For both groups this is an indication that during menstruation females are more motivated to seek out novel experiences during that phase. In the menstrual phase hormone levels are at their lowest levels and the risk of pregnancy is at its lowest so it could be speculated that estrogen and progesterone act to

curb curiosity in other menstrual cycle phases when pregnancy is more likely. This requires further testing to establish whether these results can be replicated.

Hope agency was also found to be higher in the mid-luteal phase than at menstruation, but only in hormonal contraceptive users. Hope agency is a measure of the determination an individual feels to meet their goals and further study is required here to establish why this occurs in hormonal contraceptive users but not in naturally cycling females. Again, it could be speculated that the higher levels of estrogen and progesterone experienced by naturally cycling females is curbing this determination. González-Cutre, Sicilia, Sierra, Ferriz and Hagger (2016) suggest that the need for novelty is driven by a longing to experience things that are new and that differ from everyday routines. They note that failure to seek out novel experiences can lead to boredom, negative mood and poor psychological well-being. If estrogen and progesterone do curb the drive to seek out novelty, then it would be expected that when these hormones are at their lowest level during menstruation then motivation should increase in this phase. Curbing behaviours that might be risky during ovulation and in the mid-luteal phase of the menstrual cycle may ensure that any potential pregnancy is protected. Further research should be carried out to establish whether this is replicable.

Summary: Mood fluctuations across the menstrual cycle have been widely researched (see Section 4.1) yet very little research has focused on positive mood and well-being. Findings suggest that some traits related to well-being are influenced by menstrual cycle hormones and fluctuate dependent on menstrual cycle phase. This suggests that these traits are not completely stable and can differ over time.

Results here also suggest that hormonal contraceptive users and naturally cycling females are affected differently by the menstrual cycle. Hormonal contraceptive users are not experiencing the same

fluctuations in mood and well-being as naturally cycling females. Most measures here indicate little or no effect of menstrual cycle phase for hormonal contraceptive users other than in relation to hope (agency). This may reflect a stabilising effect of hormonal contraceptives. High levels of estrogen and progesterone may curb the determination to meet goals in naturally cycling females, however, hormonal contraceptive users do not experience these high levels of hormones so their drive for goals is not curbed. Further testing needs to be carried out with a large sample of hormonal contraceptive users to establish if hope (agency) scores are similar for all types of hormonal contraceptive users.

Chapter 5. General Discussion

5.0 Thesis Aims

The primary aim of this thesis was to examine the influence of three menstrual cycle phases (and indirectly, the associated hormones involved) on attitudes and mood and well-being. Previous research examining the menstrual cycle has often been limited to testing in two phases to examine differences in psychological processes at high and low fertility (e.g. Cárdenas & Harris, 2007; Little, Jones, Burt & Perrett, 2007; Oinonen & Mazmanian, 2007). Research conducted in two phases has predominantly helped to establish the effects of estrogen on mood and behaviour, however, research reporting on the influence of progesterone is relatively limited at present. Conducting research across three phases allows for the inclusion of a test phase where progesterone levels peak (mid-luteal) while estrogen levels are still moderately high. With this in mind, this thesis aimed to examine attitudes, mood and well-being in three menstrual cycle phases (menstrual, ovulation and mid-luteal), to evaluate differences that may be attributed to the progesterone peak in the mid-luteal. A second key aim was to establish a valid, reliable and accessible testing protocol for a three-phase approach (see Chapter 3).

Previous research relating to progesterone has largely focussed on negative aspects relating to the menstrual cycle which are perceived to occur in the premenstrual phase (e.g. Andreen et al., 2009; Backstrom et al., 2003) when progesterone and estrogen are waning (five to seven days before menses). Thus, one intention in this thesis was to conduct testing in the mid-luteal phase to examine potential behavioural effects while progesterone levels were at their peak, and when estrogen levels were still moderately high. Previous research carried out with humans in the mid-luteal phase has focused predominantly on human pregnancy/fertility such as the association between progesterone

levels and live birth rates (Arce, Balen, Paltteau, Petterson & Nyboe Andersen, 2011) and diet, such as increased carbohydrate intake in the luteal phase (McNeil, Cameron, Finlayson, Blundell & Doucet, 2013). Additionally, relatively few studies have compared behavioural changes between hormonal contraceptive users and naturally cycling females and those studies that have made comparisons with small samples (e.g. Garrett & Elder 1984); or examined differences between the groups in hormone levels (e.g. Liening, Stanton, Saini & Schultheiss, 2010) or compared performance on cognitive tasks (e.g. Mordecai, Rubin & Maki, 2008). The final aim of this thesis was to examine differences in mood and well-being between these groups.

5.1 Overview of thesis

At the outset of the research programme, females were asked to take part in focus group sessions to discuss their attitudes towards the menstrual cycle, and menstruation (see Chapter 2). Previous research (e.g. Ross et al., 2003; Sassoon et al., 2011) has reported that some women perceive changes to their mood in different phases of their menstrual cycle and a focus group setting allowed these to be examined informally. Conversations showed that many of the women perceived changes in their mood during their cycles, and several stated the belief that these changes were caused by hormonal shifts (see Chapter 2, Section 2.10). There is some evidence to suggest that mood is related to hormones (e.g. Halbreich, Endicott, Goldstein & Nee, 1986; Shors & Leuner, 2003), and it is conceivable that knowledge of these could have influenced the focus group conversations. Male focus groups were also carried out to examine not only their attitudes towards the menstrual cycle and towards menstruating females, but to also examine whether the female perceptions which assumed male negativity towards the cycle would be supported. Finally the thesis aimed to examine perceived changes in mood and well-being empirically, across three menstrual cycle phases. Participants for this study were assigned to test phases using the testing protocol described in Chapter 3 (for an evaluation see section 5.4). Estrogen effects have been well established with studies carried out

using a two phase approach (e.g. Jones et al., 2008; Roney & Simmons, 2008). However, if the influence of progesterone is to be examined a third testing phase should be included (Bayer & Hausmann, 2012). In this thesis quantitative testing was conducted during the menstrual phase, ovulatory phase and the mid-luteal phase. Testing at the mid-luteal allowed for behaviour to be monitored when progesterone levels are high and estrogen levels are in their second but reduced peak. The effects of estrogen in combination with high levels of progesterone are rarely reported and previous research examining progesterone effects often focus on females' negative experiences in the premenstrual phase of their cycle. The intention here was to find out if established differences reported in the ovulatory phase of the cycle (peak estrogen levels with raised progesterone levels) are diminished or enhanced in the mid luteal phase (peak progesterone levels with raised estrogen levels).

Participants were asked about hormonal contraceptive use and were grouped accordingly so that comparisons could be made between hormonal contraceptive users and naturally cycling females. It should be noted however that treating the hormonal contraceptive users as a homogenous group was not optimal since participants used a variety of different types and generations of hormonal contraceptive that potentially varied in the hormones contained. Some participants were able to given the brand name of their hormonal contraceptive pill which allowed generation to be identified. Unfortunately, numbers in some of these sub groups (generation of hormonal contraceptive) were very small and did not allow for meaningful statistical analysis.

5.2 Key Findings

***5.2.1 Testing protocol*:** Prior to examining mood changes, a crucial aspect of this work was to establish a reliable protocol for identifying where testing should be carried out if differing levels of hormones were to be captured. In Chapter 3, the aim was to identify a method that would allow a

robust means of estimating where, in different length menstrual cycles, differential levels of estrogen and progesterone could be captured. Ideally, the method would be inexpensive and non-invasive but high in accuracy and a testing protocol was successfully developed that met these aims. Participants were asked to self-report menstrual cycle length during the recruitment process and, based on this, test dates for the ovulatory and mid-luteal phases were estimated (see table 3.1). The testing protocol was found to predict the test phases with a high degree of accuracy based on participants' self-reported menstrual cycle length. The testing schedule proved to be robust and able to withstand some deviation from the averages without invalidating the underlying assumptions about hormone levels in each phase. The stability of the luteal phase, combined with the length of time that hormones are elevated, meant that testing in the predicted mid-luteal phase would capture high levels of both estrogen and progesterone.

***5.2.2 Menstrual cycle phase effects*:** Few menstrual cycle phase effects were found, although there was evidence to suggest an influence on some aspects of well-being. Overall, participants were found to be significantly more mindful in the mid-luteal phase compared to their menstrual phase. Curiosity (stretching) was found to be significantly higher in the menstrual phase than during the ovulatory phase. As discussed in Chapter 4, increased mindfulness in the mid-luteal phase may be an indication that females are monitoring their body for signs of menstruation (Ostafin & Marlatt, 2008). This might be attributable to high levels of progesterone in combination with raised levels of estrogen, however, it might be that at this point participants are generally in a positive frame of mind, and this simply reflects the point in their cycle where they are post-ovulatory and still around a week away from menstruation. Increased Curiosity (stretching) in the menstrual phase suggests that females are more motivated to find new experiences at this point in their cycle, compared with ovulation. Naturally cycling females were also found to be higher in Curiosity (embracing) in the menstrual phase than in the ovulatory phase, suggesting that this group are more willing to embrace new or unpredictable

experiences. Broder and Hohmann (2003) reported that naturally cycling women decreased their risky behaviour during ovulation, however, this change in behaviour was not observed in hormonal contraceptive users. Taking this in to account, it could be proposed that at ovulation, naturally cycling females are 'at risk' of pregnancy and therefore they are more likely to avoid novel or risky situations. Hormonal contraceptive users are protected from the risk of pregnancy so do not display this behaviour. However, phase and cycle type effects in this thesis, are reliant on the accuracy of the testing protocol identifying peak levels of progesterone and high levels of estrogen in the mid-luteal phase. This will be evaluated in detail in section 5.4.

These results indicate that some aspects of well-being may be influenced by menstrual cycle phase, however, the testing protocol used assumes that ovulation has taken place on the predicted day. Without solid evidence that ovulation did occur, any effects found at that time may not be directly related to peak levels of estrogen. It is possible that some participants ovulated earlier or later than the predicted day and therefore testing for some participants may not have captured the short-lived estrogen peak. Some changes in well-being were detected in this phase, but these failed to meet significance and this may be a reflection that testing in this phase did not capture peak hormone levels for all participants. Capturing progesterone in the mid-luteal phase based on estimated day of ovulation is likely to be less problematic. The mid-luteal surge of progesterone is more prolonged than the estrogen peak at ovulation (see Figures 3.2 and 3.3), so testing seven days after the estimated day of ovulation will still capture the period when progesterone levels are high (and estrogen levels are moderately high). Some measures of well-being were found to increase in this phase as had been expected and this may be an indication that testing in this phase did capture peak hormone levels – See Section 5.4 for an evaluation of the testing protocol.

***5.2.3 Cycle type effects (Natural cycling females compared to hormonal contraceptive users)*:** No significant differences were found between the groups when mood and well-being were examined. This finding is unexpected as naturally cycling females have higher average estrogen than hormonal contraceptive users and estrogen has previously been related to increased positive mood and well-being (Brown, 2014; Farage et al., 2008; Shors & Leuner, 2003). Again this might be an indication that not all naturally cycling females were being tested during the peak hormone phase, and confirms that accurate identification of ovulation is key to this type of research.

***5.2.4 Hormones and hormonal contraceptive use*:** No significant differences between hormonal contraceptive users and naturally cycling females were found although there were within groups differences related to menstrual cycle phase. Curiosity (Embracing) scores differed significantly across the menstrual cycle but no significant differences were found for hormonal contraceptive users. Hope (Agency) scores differed significantly across the menstrual cycle for hormonal contraceptive users, but no significant differences were found across the cycle for naturally cycling females. Differences within the hormonal contraceptive user group must be treated with caution as this was not a homogenous group. As mentioned throughout the thesis, not all participants used the same type or generation of hormonal contraceptives. Chapter 1 (section 1.6) discusses they ways in which different types of hormonal contraceptives may comprise of different strengths and combinations of hormones. Newer generations of hormonal contraceptives are lower in estrogen and progesterone (combined oral contraceptives COC's) or may contain only progesterone (POP's). Added to this, fourth generation hormonal contraceptives (COC's) also have anti-androgenic properties, and this which may influence the mood of users.

It is perhaps surprising that females do not switch to the latest generation of their hormonal contraceptive type, however, this is not as straight forward as it seems. Many contraceptive pills carry

different side effects and risks (Spencer & Bonnema, 2011) and therefore, when females find a suitable contraceptive pill that suits them, they tend to keep using this brand. Also, risks associated with certain types of contraceptive pills are often reported in the media and can induce some level of change. De Vries, van den Berg and de Jong-van den Berg (1998) reported that after a pill scare (linked to deep vein thrombosis) was reported in the media with third generation pills, young females were more likely to switch back to second generation pills. In the current studies, there were insufficient numbers in any particular class of contraceptive users (type or generation) in order to be able to create a single or multiple comparison groups. It is very likely that within each of the hormonal contraceptive groups there was a unique mixture of type or generation of hormonal contraceptive, making conclusions about hormonal effects difficult. Women using triphasic COC's receive differing levels of hormone over the course of their cycle while women using POP's receive a continuous level of progesterone over the course of their cycle. It is likely that this will influence the magnitude of any effects. This needs to be further explored so that differences within this group can be examined to establish if the type of contraceptive taken can influence mood and well-being.

5.2.5 Evaluation of findings

As previously stated (Section 5.1), an important aspect of this thesis was developing an effective, but inexpensive, and non-invasive, protocol for predicting testing phases to allow for the development of a three-phase approach. Key to this was the capture of the mid-luteal progesterone surge, which occurs alongside moderately high levels of estrogen. Empirical and theoretical evaluation of this protocol determined that it was successful in terms of predicting the timing of the mid-luteal phase. This used a self-reported estimate of menstrual cycle length, showed to be a good predictor of actual cycle length, and was shown to do so with a high degree of accuracy (see Chapter 3). Based on this,

it is highly likely that any effects related to the mid-luteal phase across the thesis can be linked to high levels of progesterone, moderately high levels of estrogen, or a combination of both hormones.

An important aspect to evaluate, is whether the current protocol has potential confounds built into the way that testing was carried out. The accuracy of phase determination is based on the assumption that ovulation has taken place and that levels of hormones will be at peak levels when testing takes place. Without solid evidence that ovulation did occur, any effects found at that time may not be directly related to the peak levels of estrogen assumed at this point (see Chapter 3). It is certainly possible that some participants ovulated earlier or later than the predicted day and therefore testing for some participants may not have captured the relatively short-lived estrogen peak. This will be further discussed in Sections 5.4 and 5.5.

The issue of the action of multiple hormones in each phase also needs to be evaluated**.** The low levels of all hormones during the menstrual testing phase (days 2-4) ensures that all hormonal influence during this phase is minimal and serves as a useful benchmark to compare against other phases [see Section 3.4.6]. The mid-luteal testing phase has been examined in detail (Chapter 3), and the methodology used in this thesis ensures that the current testing is picking up relatively high levels of both progesterone and estrogen during this testing phase. This raises a difficulty for the current protocol – the effects observed could be driven by elevated levels of one or both of these hormones. The potential limitation with all mid-luteal effects reported is that it is not possible without artificial manipulation of hormone levels, to determine whether any effect is only caused by only a single hormone. This was noted from the start of the thesis (Chapter 1) however, the key aim was not to try to make an absolute claim about the role of progesterone but to establish where mid-luteal effects were occurring irrespective of which hormone peak was directly responsible, and use this information

to suggest where future investigations should build. Suggestions for how to take this forward are outlined in section 5.5 – future directions.

The digital ovulation data from Chapter 3 showed that 15 out of 19 participants (79%) were recorded as ovulating during the testing period. This suggests that even a conservative estimate of occurrence of ovulation across the quantitative chapter would be somewhere above 80% of the time, allowing confidence that the majority of the sampling would involve an ovulation. Looking at the current sample used to examine mood and well-being, the mean age was 27.9 years, which corresponds with the age group where Metcalf and MacKenzie (1980) found 88% of all participants to ovulate across their sample period. If there was a single anovulatory cycle, then the effects would be most clearly felt as a reduction in levels of hormones such as estrogen and progesterone, particularly in the mid-luteal test phase, which would limit their influence. It is advisable for future studies to measure ovulation, rather than to estimate it, in order to get an even higher certainty of having the expected hormonal levels in each phase (see Section 5.5 - Future Directions).

The lack of significant menstrual cycle phase effects in naturally cycling females may reflect this flaw in the testing protocol. It may be that for some participants peak hormone levels were missed with testing taking place before or after ovulation. Under these circumstances effects may still be detectable in the mid-luteal phase, which has a longer peak hormone threshold, but would not occur or not be detected in the ovulatory test phase. It may also be the case that the measurements employed in this study lacked discriminatory power. Very little research using these instruments has been carried out in relation to the menstrual cycle and it may be that other measurements of positive mood (e.g. Positive and Negative Affect Schedule (PANAS) Watson, Clark & Tellegan, 1988) and well-being (e.g. Warwick-Edinburgh Mental Well-being Scale (WEMWBS) Clark et al., 2011) would be more

discriminatory. Further research should be carried out using these alternative measurements to examine this.

5.3 Limitations

5.3.1: Sample size, participant variation and recruitment

Recruitment of participants willing to chart three complete menstrual cycles or to complete three testing sessions was generally problematic and the average attrition rate over the course of the thesis was 48%. A reluctance to take part in menstrual cycle research meant that mood and well-being studies were conducted with a relatively small sample (n = 86) but this is not unusual in menstrual cycle research (see Chapter 3 section 3.1). The majority of participants were students and many are critical of this practice arguing students are not representative of the population (e.g. Henrich, Heine & Norenzayan, 2010; Myers, 1983) or that results differ when non-student populations are tested. Metcalf and MacKenzie (1980) also note that students are theoretically more likely to exhibit anovulatory cycles compared with non-students, especially if they are aged between 20 and 24. They also found that relationship status could influence ovulation and a current weakness of the present study was that this was not recorded (see Section 5.4.3 for a more detailed discussion).

5.3.2: Limitations related to the current testing protocol

The main limitation with the testing protocol relates to the *ovulatory* test phase rather than the mid–luteal test phase. As previously mentioned, some participants may have ovulated earlier or later than the predicted day of ovulation based on menstrual cycle length. This means that potentially some participants may not have been tested at the height of the estrogen peak. It is also possible that some participants did not ovulate and this cannot be detected unless hormonal assessments have taken place. Progesterone levels in the mid-luteal phase falling below 3 nmol/L confirm that ovulation has

not occurred (Hamilton-Fairley & Taylor, 2003). Full hormonal assay was not available for this thesis so progesterone levels in the mid-luteal phase could not be confirmed. When ovulation does not occur levels of both estrogen and progesterone are reduced over the remainder of the menstrual cycle. However, they do continue to fluctuate and may still produce effects that are measurable (Hambridge et al., 2013) but hormonal analysis would be required to establish this. While we do not know the actual number of cycles where ovulation did not occur, most women within the age group sampled here have been shown to ovulate regularly. If in future studies ovulation was confirmed prior to mid-luteal testing, then this would be minimal.

5.3.3 Testing phase in qualitative chapter

Testing conducted in the mood and well-being Chapter (Chapter 4) involved mapping the cycle phases for each individual, so data could be collected at the menstrual, ovulatory and mid-luteal phases. The qualitative data collected for Chapter 2, however, did not control for cycle phase. Participants took part in a single focus group and were not asked to identify where they currently were in their cycle (i.e. day). They were not asked directly for information relating to cycle length or hormonal contraceptive use (although some did offer this information) as it has not been expected that this would influence narratives. In hindsight this information could have been recorded and differences in responses between groups might have led to the emergence of different sets of themes related to phase and/or hormones.

5.3.4 Multiple Hormones and Testing Protocol

As indicted above (section 5.3) estrogen is also relatively high when progesterone is high during the mid-luteal phase, meaning that the current methods do not allow certainty in establishing which hormone is actually responsible for any particular change. As both are always high for naturally cycling

females it is unlikely disentangling the effects of individual hormones can be achieved in this group without artificial manipulation of hormone levels. Arguably, the best route is to test progesterone-only pill users (see Chapter 1 section 1.5.1) which would seem to be possible, even if participants taking this type of pill appear to be scarce. Hausmann (2017) suggests another possible group, females taking drugs such as tamoxifen (selective estrogen receptor modulators) which block the action of estrogen and are used as a treatment for some types of breast cancer. While this may be theoretically possible, it would be challenging to gain access to such a group and it is likely that they may have other issues related to their medical conditions which could complicate interpretation of findings.

As the current testing protocol was also based on average predicted day of ovulation, then it may be wise to consider a potentially more accurate method for testing the influence of estrogen, making use of the digital ovulation kits used in Chapter 3. In order to ensure that a high level of estrogen is captured, an appropriate protocol might involve testing on the day of the LH surge or one day afterwards. This would have the dual purpose of ensuring that ovulation had occurred (and allowing the mid-luteal phase to be more accurately estimated) but would also allow the experimenter to be sure that testing was indeed at the point of ovulation.

It is also the case that testing around ovulation may be subject to some further scrutiny. The current testing protocol took into account the body of work which suggested that estrogen levels peak at ovulation (e.g. Lazzaro, Rutledge, Burghart & Glimcher, 2016) but not all researchers support this idea. For example, Hausmann (2017) suggest that it peaks around one day before ovulation and so testing on or after ovulation could mean that the influence of peak estrogen is missed. It should also be noted that immediately prior to ovulation there is a surge of both LH and FSH (see Chapter 1), so testing in the 'ovulatory phase' is likely to be drawing on influences from several hormones rather than mainly

capturing estrogen. This suggests that it is advisable to have a way of specifically testing for estrogen, and future work will attempt to do this (section 5.5.1).

5.3.5 Hormonal contraceptive users

Treating the hormonal contraceptive users as a single group was not optimal since not all participants in this group were not using the same type and/or generation of hormonal contraceptive. As discussed in Chapter 1 (Section 1.7.1), some hormonal contraceptives contain a combination of estrogen and progesterone, while others contain progesterone only. Additionally hormone levels in contraceptive pills differ depending on generation with some fourth generation hormonal contraceptives containing anti-androgenic properties. It is feasible therefore, that mood and well-being within this group varied according to hormonal contraceptive type, although overall mood was relatively unchanged across the cycle overall. Sample size was not large enough to allow for this group to be separated by type and generation for comparison. This was problematic due to the diversity of the hormonal contraceptive group. Participants in this group were using different types and generations of hormonal contraceptives but were treated as a single group. It is therefore difficult to draw any valid conclusions from this group.

5.3.6 Cycle length variability

The general expectancy of an ovulation rate of around 80% is supported in other studies. For example, a study by Solomon et al. (2002) examined the usual menstrual cycle pattern in a very large cohort sample of female nurses in the USA (120,000+), asking them to 'describe the regularity of your usual menstrual periods between ages 20 and 35 when you were neither pregnant nor using oral contraceptives'. Self-report data found that 84.8% of the sample agreed that they were very regular/usually regular. A similar examination of this cohort when aged 29–35 years, found that 87%

reported cycles that were regular. A limitation of the current work was that there was no objective measure of regularity of cycle, and while research suggests a high level of regularity, this cannot be confirmed. It would be advisable for future studies to require participants to keep a menstrual diary for at least three cycles in order to measure degree of regularity (see 5.5.2).

5.4 Future directions

5.4.1 Alternative mapping of the cycle

Throughout the thesis cycles were mapped according to cycle length, and phases/testing days were calculated from the first day of menstruation. As the current testing protocol was also based on average predicted day of ovulation, then it may be wise to consider a potentially more accurate method for establishing the peak influence of estrogen, making use of the relatively inexpensive digital ovulation kits used in Chapter 3. Each participant would be asked to use a digital ovulation test, but rather than simply test from the point of ovulation, the order of phase would be controlled. For example, when participants ovulate, some would be asked to complete the testing straight away (i.e. to test in the ovulatory phase), however, some would be asked to wait seven days before they were tested for the first time (to capture the progesterone peak and moderate estrogen level in the mid-luteal phase), while others would be asked to begin their first test session in their next menstrual phase and so on. This would ensure that there were no phase order effects. A summary of proposed testing phase orders can be found in Table 5.1

Table 5.1: Proposed order of testing phases

Test phase 1	→	Test phase 2	→	Test phase 3
Menstrual (evident)	Use digital ovulation kits days 13-16 to confirm	**Ovulatory**	Test seven days later	**Mid-luteal**

Menstrual (evident)	Use digital ovulation kits days 13-16 to confirm, then wait seven days to test for phase 2	**Mid-luteal**	Use digital ovulation kits again on days 13-16 of next cycle to confirm	**Ovulatory**
Ovulatory Use digital ovulation kits days 13-16 to confirm	Wait until menstruation begins	**Menstrual**	Use digital ovulation kits again on days 13-16 to confirm and then test seven days later	**Mid-luteal**
Ovulatory Use digital ovulation kits days 13-16 to confirm	Wait seven days	**Mid-luteal**	Wait until menstruation begins	**Menstrual**
Mid-luteal Use digital ovulation kits days 13-16 to confirm, then wait seven days to test for phase 1	Then wait for menstruation to begin	**Menstrual**		**Ovulatory**
****Mid-luteal** Use digital ovulation kits days 13-16 to confirm, then wait seven days to test for phase 1 (M-L)	Allow menstruation to occur then test on days 13-16 of next cycle to confirm ovulation	**Ovulatory**	Wait until next menstruation begins to start test phase 3	**Menstrual**

A few of the testing orders outlined in Table 8.1 are not optimal as testing would firstly take a long time to complete, and secondly, would require two phases of digital ovulation testing. However, if absolute counterbalancing was to be conducted while using digital ovulation detection kits, then Table 5.1 reflects a possible method for achieving this.

5.4.2 Estimates of Regularity

The testing protocol used for this research requires further validation and thus recruitment of naturally cycling females should continue. This would involve testing around 100 individuals making use of digital ovulation kits and this would allow the tracking of both regularity but also rate of ovulation. This would give a better understanding of how accurate the protocol could be, when used to estimate phases and provide a clearer picture of the rate of anovulatory cycles. Participants would be aged between 17 and 40 (as long as they are pre-menopausal), and an effort would be made to cover the whole age range as equally as possible. It is also advisable to test females from a wide range of backgrounds and not solely students.

Study 1: Estimate of regularity of ovulation across three cycles. Upon recruitment participants would be asked to self-report menstrual cycle length and to chart three menstrual cycles using digital ovulation predictor kits in each cycle. Based on the information provided and data collected during the development of the testing protocol (see Chapter 3 Section 3.7), an estimate would be made as to where ovulation would take place. Participants would be asked to start using digital ovulation kits two days before the predicted day of ovulation and to continue using them for four days unless a LH surge is detected sooner. Data would be scrutinised to further assess the efficacy of assigning test phases based on menstrual cycle length.

Study 2: Stability of cycles - Upon recruitment participants would be asked to self-report menstrual cycle and to chart six menstrual cycles using digital ovulation predictor kits in each cycle. Based on their self-reported menstrual cycle, participants would be asked to start using digital ovulation kits two days before the predicted day of ovulation and to continue using them for four days unless a LH surge is detected sooner. This would be repeated across six cycles, and a wide range of ages in order to establish reference values for degree of stability of cycles, for each age group.

5.4.3 Qualitative interviews in three phases and contraception type (also younger and post-menopausal)

As highlighted in Section 5.3.4, information relating to cycle phase and hormonal contraceptive use was not collected during the focus groups (Chapter 2). Future work in this area would involve collecting this important information as these variables could potentially influence responses. It is proposed to conduct focus groups making use of the three phase protocol developed in this thesis, in order to examine whether attitudes are influenced by cycle phase. Collecting information on cycle type (natural cycle or hormonal contraceptive use) would also be valuable as this might influence female attitudes and mood (e.g. Brown, 2014; Farage, Osborne & MacLean, 2008).

An extension of the focus group research could involve testing younger females (approximately 16-20), as well as post-menopausal females to examine their attitudes towards menstruation. Previous research has shown that menstrual phase influences depressive symptoms in adolescents (e.g. Dorn et al., 2009; Kiesner & Poulin, 2012) and it has been reported that females who hold more negative views towards the menopause will report more of the associated symptoms (Ayers, Forshaw & Hunter, 2010). As there is evidence of attitude change in young adults, and post-menopausal females, it would be useful to examine these in more depth, in a focus group setting.

5.4.4 Detailed investigation of hormonal contraception

As mentioned in Section 5.3.5, it was not possible to conduct analyses looking at separate types of hormonal contraceptives. Future studies will aim to recruit large samples of hormonal contraceptive users so that a more detailed investigation into hormonal contraceptive type (POP; COC etc.) can be conducted using the three phrase approach. This will allow not only for comparisons with naturally cycling females, but also between the different generations and type, of hormonal contraceptives. This is an important contemporary issue as changes in the type of hormonal contraceptive being prescribed

means that more 'progesterone only' contraceptives are being taken by young women (see Chapter 1, Section 1.7.1). In addition, many young women are choosing long acting reversible contraceptives (LARC's) and to my knowledge, no research has been reported comparing the performance of users with participants using combined oral contraceptives (COC's). Participants in the studies in this thesis were asked about the type of contraceptive they were using but very few were using third or fourth generation contraceptives at the time of testing. This, combined with the small sample size in general, meant comparisons could not be made between the generations, but it is an aim to pursue this in future work.

5.4.5 Creation of scales, questionnaires from themes that emerged from focus groups

Another proposed future study would be to create, and/or administer, a questionnaire/attitude scale relating to the themes that emerged from the focus groups and subsequent online questionnaires. For example, a number of responses consistently used the word 'disgust' when describing menstruation, and to assess this quantitatively, the current online questionnaire would be modified so that responses would take the form of a Likert scale (and participants asked to rate how much they agree with these statements over the course of three phases). In addition, an existing psychometric measure of disgust would be administered and participants asked to complete the questionnaire three times across the menstrual cycle. For example, van Overveld, de Jong, Peters, Cavanagh, and Davey (2006) used the Disgust Propensity and Sensitivity Scale (DPSS), demonstrating that both aspects are separable. This would be interesting to make use of across the cycle, to see if responsiveness to disgust changed according to phase.

Measures of well-being were found to fluctuate over the course of the menstrual cycle suggesting that progesterone and estrogen may curb some behaviours related to curiosity, novelty seeking and goal

seeking. Very little research relating to positive traits and well-being has been reported thus far and these results should be further examined. These behaviours were found to be significantly higher in the menstrual phase than in the mid-luteal phase suggesting progesterone may be the predominant hormone acting to curb these behaviours. Future experiments would be carried out using self-report measures of hope and curiosity in the mid-luteal phase and at menstruation to further examine the role of progesterone in curbing these behaviours.

5.4.6 Hormonal assays

The most aspirational future study is to conduct menstrual cycle research that uses the most sophisticated hormone measures (see Section 3.4.5). These involve the use of invasive sampling techniques (blood; urine and saliva), and although they are not always the most comfortable methods for participants, they are the most accurate. It should be noted, however, that this is also by far the most expensive method and external funding would need to be sought in order to achieve this.

5.5 Conclusion

The aim of this thesis was to examine the influence of the menstrual cycle on attitudes, mood and well-being. A three-phase approach was used to include testing in the mid-luteal phase when progesterone levels peak and estrogen levels are moderately high. Although three phase testing has been reported previously, much of this has been carried out in the premenstrual phase when progesterone levels are low. To ensure testing was carried out when progesterone levels were at their peak, a protocol for estimating the mid-point in the luteal phase was developed. Based on self-reported menstrual cycle length, day of ovulation was estimated and the mid-luteal phase was identified as occurring seven days after estimated day of ovulation. Pilot studies using ovulation predictor kits indicated that based on cycle length, ovulation took place within ± 2 days in 93% of charted cycles. Results revealed some

menstrual cycle phase effects in naturally cycling females (significantly higher curiosity (embracing) in menstrual phase than in ovulatory phase) and in the hormonal contraceptive users (significantly higher hope (agency) in the mid-luteal phase than in the menstrual or ovulatory phases). Additionally all participants were found to be significantly higher in mindfulness in the mid-luteal phase than in the menstrual phase. Ovulation, however, could not be confirmed, so those effects found in the ovulatory phase lack validity and might not be attributable to estrogen. Effects reported in the mid-luteal phase, however, are likely to be related to peak progesterone in combination with estrogen. The testing protocol proved to be an effective means of estimating where the mid-luteal progesterone surge occurs based on menstrual cycle length. If, however, future testing is to include an ovulatory phase, digital ovulation predictor kits should be employed so that the test phase coincides with the estrogen peak.

Findings from the focus group session indicate that for some young women, menstruation remains something they tolerate and which remains for them, a predominantly negative aspect of womanhood (Jackson & Falmange, 2013). The findings were somewhat mixed, as while some women continue to hold a negative and mainly stereotypical view of menstruation (Thornton, 2013) others also hold positive attitudes towards their menstrual cycle. A biopsychosocial model suggests that biology is not the sole factor influencing attitudes towards menstruation (Mohamadirizi & Kordi, 2013). Women are influenced by social and environmental factors such as interaction with friends and family, as well as psychological factors such as anxiety and stress. These factors can influence how women perceive themselves and their bodies, which in turn, may influence their attitude towards menstruation. Expectations and attitudes towards menstruation are influenced not only by a woman's own expectations, but also the expectations of others (Stanton, Lobel, Sears & Deluca, 2002). For example, expectations can be influenced by media and advertising (Chrisler & Levy, 1990; Coutts & Berg, 1993), and can also be influenced by friends and family (Wilson, Turner & Keye, 1991; Fugate Woods et al., 1998). Narratives examined in the focus group sessions confirm that all of these factors

do play a role in female attitudes towards their menstrual cycle. Male responses were also mixed with some males expressing disgust while others described menstruation as a natural process and therefore not disgusting. Males appeared surprised when asked if they were disgusted by menstruating females, which implies they had never considered this previously. This should be further examined in a focus group setting, or a one to one interview to allow responses to be followed up.

To conclude, the main achievements stemming from this thesis are: a) The establishment of a novel and accurate protocol for charting a three phase testing schedule (which included a focus on the mid-luteal rather than the premenstrual phase) and b) Conducting focus groups with females and males examining attitudes towards menstruation.

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Appendices

Appendix 1.0: Publications

1.1 Published paper

I don't want to talk about it: Why are young women reluctant to participate in menstrual cycle research?

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Recruiting participants for research can be challenging, and when a specific group is required this can become more difficult. Our current programme of research focuses on quantitative changes in cognition across the menstrual cycle in women with natural cycles and in women with hormonally controlled menstrual cycles. So far, the recruitment of women who are willing to complete multiple testing phases and/or menstrual cycle charts has proven problematic, and unfortunately this appears to be typical for this kind of research. When previously examining the influence of PMS on mothers' attitudes to their children's behaviour, McAra (1999) found that the response rate was low, yielding just 23 responses from the 100 participants who had freely agreed to take part. Lowe (2005) contacted 130 women for interview, yet only 11 were actually interviewed. Grace and McBride-Stewart (2007) had the agreement of 560 women, and, although 150 completed their questionnaire, only 40 completed it fully. This motivated us to examine the issue from both a theoretical and a practical angle.

We first considered how many women should be tested in such a study if the result is to be considered statistically valid. A review of the literature revealed that research can be based on results from very small samples with some studies using as few as eight participants (e.g. Garrett & Elder, 1984; Hausmann, 2005; Solis-Ortiz & Corsi-Cabrera, 2008; Bell & Bloomer, 2010; Brambilla, Speca, Pacchiarotti & Biondi, 2010 and Lawrence, Klein & Carter 2010). Smaller samples are useful when multiple testing and complex hormonal measurements are used. But as individual menstrual cycles are so varied, and are generally not the uniform 28 days as reported in many studies, drawing conclusions based on such small numbers could be rather presumptuous.

Of course, not all research into the menstrual cycle uses such small numbers of participants. In fact, many studies have used large pre-existing data sets (e.g. Resnick *et al*, 2006 and Thilers, MacDonald & Herlitz, 2006), showing that there may be more than one valid answer to the question of sample sizes. Each has associated advantages and disadvantages. Small samples are clearly easier to recruit, but,

while they provide rich and often in depth information about the experiences of a few women, are unlikely to allow us to infer much about women's experiences in general. On the other hand, large samples provide more information about differing menstrual cycles. However, the recruitment of larger samples is difficult and time consuming. Taking these issues into account, we suggest that recruiting numbers in the region of 40 – 50 women would allow us to confidently draw valid conclusions about the role of the menstrual cycle in cognitive performance.

How do researchers in this area find their participants? The most common methods of recruiting large numbers of participants is to recruit from within education (e.g. Roder, Brewer & Fink, 2009; and Keisner & Pastore, 2010) or to offer an incentive such as cash (Halari *et al*., 2005; Lokken & Ferraro, 2006 and Van Anders & Hampson, 2005), or course credits (Burton, Henninger & Hafetz, 2005, Oinonen, 2009 and Scarborough & Johnstone, 2005). Several studies have used existing data sets to good advantage. Using data from the Women's Health Initiative (WHI) and the Women's Health Initiative Memory study (WHIMS) Resnick et al (2006) examined the effects of combination estrogen and progesterone replacement on cognition and affect in 1416 women. Thilers, MacDonald and Herlitz (2006) examined the data of 1276 females from the Betula study into health, aging and memory. However, these options may not be available to all researchers, and however useful pre-existing data sets are, they limit and determine what the researcher can examine.

We recruit most of our participants from undergraduate psychology student populations. Students studying psychology at undergraduate level tend to be predominantly female, and in Scotland in the academic session 2007 – 2008, 78.6% of psychology undergraduates were female, providing a large pool of participants from which to recruit (www.scotland.gov.uk).

The student population represents a high proportion of participants used in psychology experiments (Korn, 1988). Many are critical of this practice, arguing students are not representative of the general

population (Henrich, Heine & Norenzayan, 2010; Myers, 1983; Smart, 1966 cited in Wintre, North & Sugar, 2001) or that results differ when non student populations are tested. Indeed, as Medin and Atran (2004) point out, results from studies in cognitive psychology are often shown to differ when the sample is not drawn from undergraduate psychology courses, which may have implications for our research. Finally Jourard (1968 cited in Shultz, 1969) argues that there is no guarantee students are honest in how they behave or respond during research. In spite of this critique, the practice of recruiting students as participants continues. Indeed, Wintre *et al.* (2001) reviewed a selection of journals covering a period of 20 years, finding that 91% of the 1719 articles examined recruited participants from undergraduate psychology courses.

Recruitment issues

This begs the question, why are student populations considered problematic? As noted previously, recruitment remains difficult within this body of research, with students signing up to take part, but failing to attend all testing sessions or failing to complete and/or return menstrual charts. We recruited a group of 94 students for a pilot study and found that of the 73 women, 42 signed up and of the 35 who started the study, only 26 actually completed testing.

We believe there may be a number of explanations for why our recruitment of students has proven to be so problematic. Enigmatically, while recruiting for our research we regularly find women engaging in lively and often extended conversations about their personal experiences of menstruation, and asking questions about the research and what might be expected. These spontaneous sessions see women exchange narratives on menstruation in open, enthusiastic and often frank terms. Narratives have been used successfully to gain insight into views on, and experiences of negotiating menstruation in social contexts (Allen & Goldberg, 2009; Burrows & Johnson, 2005). But we find the problem starts when the

talking stops, with women subsequently failing to complete testing sessions, particularly those that require them to give specific information about themselves and their own cycles.

Time scale may be one reason female students fail to complete all aspects of testing. Most research examining the menstrual cycle requires women to take part in more than one testing session. Participants are often required to complete a menstrual chart or questionnaires over one or more cycles, and a high proportion fail to complete these. Participation in lengthy research projects may become a low priority when coursework deadlines or exams are approaching. This is one common drawback of recruiting from a student population. It is conceivable that students sign up for research for impression management reasons, feeling they should be seen to take part in staff research. Once they are no longer taught by the staff member the obligation to finish testing may diminish.

Some younger students may feel uncomfortable with the idea of staff or fellow students knowing they are taking part in research relating to their menstrual cycle, or simply feel embarrassed when asked questions on the subject. In our experience students initially present themselves as keen to take part in research but this willingness to take part does not continue until the end of testing. Beausang and Razor (2000) point out that often girls learn about menstruation and menarche as dirty or shameful. This negative view is noted throughout history from as early as 3000 BC when Mesopotamians isolated menstruating women. Romans such as Pliny the Elder, (Bostock & Riley, 1855) the ancient Greeks, including Hippocrates and Galen (Brock, 1916) and the bible (e.g. Ezekiel 22: 1 – 11 and Leviticus 15: 19 - 30), brand the menstruating woman as unclean. Stubbs (2008) argues that adolescents are still being given mixed messages about menstruation and that despite being a natural process it is something that should be hidden. Girls are encouraged to welcome menarche as normal and natural, yet sanitary products are designed to ensure no one will know she has her period. These messages could act to influence women's perceptions and attitudes towards menstruation, which can remain throughout their lifetimes. Stubbs

(2008) notes that adolescent attitudes towards menstruation remain negative into adulthood and can contribute to body shame and self-objectification in later life. Negative attitudes and beliefs have similarly been shown to influence how women feel about other reproductive functions such as breastfeeding (Johnston-Robledo, Sheffield, Voigt, & Wilcox-Constantine, 2007) and childbirth (Moloney, 2010).

It might be that our female students also learn about menstruation in this negative way. An examination of the literature shows that a great deal of research still reports negatively on the influence of the menstrual cycle, connecting this with a *decline* in cognitive performance, (Wright & Badia, 1999), *negative effect* on mood (Natale & Alberatazzi, 2006) and links with suicide attempts (Baca-Garcia *et al*., 2010). Students searching for menstrual cycle research are more likely to find papers reporting negative aspects of menstruation rather than positive influences (e.g Hampson, 1990). Unless a shift towards more positive research develops, such negative viewpoints are unlikely to change.

This negativity and stigma may be a factor contributing to the reluctance we are finding when recruiting female students. Arguably, our use of ovulation kits contributes to that reluctance. Perhaps students who are in relationships fear that husbands or boyfriends will regard their use of ovulation kits as an attempt to become pregnant. Although we have no empirical evidence of this thus far, several women joked about hiding the ovulation kits from partners or parents, which may be an issue worth pursuing. It might also be argued that the very nature of the ovulation kit may put potential participants off because it is a test often used by women who hope to become pregnant.

Although many believe that using student populations limits findings (Myers, 1983; Wintre *et al.*, 2001 and Henrich *et al.,* 2010), we contend here that this population, and more specifically psychology students, are arguably an ideal pool to draw a sample from for menstrual cycle research. Within our area of research age is an important factor, because menstrual cycles can be irregular in the first few years

following menarche. Irregular cycles also become more common as women move towards menopause. For testing purposes, including young women with regular cycles in the research allows for more accurate pinpointing of the phases of the cycle. In terms of age, the majority of undergraduate students are in their late teens to early twenties, with 65% of students in further and higher education in Scotland between 2007 and 2008 aged between 16 and 30. In undergraduate psychology courses this increases to 86%, providing an ideal age range for testing (www.scotland.gov.uk). A student cohort then provides a large number of young women who are likely to have regular cycles and who are available to take part in research, but are alas not willing.

The question remains one of how these students can be recruited and retained when money or course credits are not available as incentives. We currently rely on the interest and goodwill of students when we ask them to take part in our research. Perhaps one way to encourage participation would be to make students aware of the positive aspects of menstruation. As much of the research on menstruation continues to take a negative perspective, it may be that the dominance of such research shapes the negative attitudes of many women towards menstruation. Our own research intends to examine the menstrual cycle in a positive way, focusing on enhancements in cognitive performance rather than a decline in performance. Perhaps this positive approach should be emphasised more clearly.

Future directions

As outlined previously, our most successful recruitment sessions have been those in which potential participants are invited to group discussions about what the research involves. This invariably leads to the groups talking about their own menstrual cycles, with women relating their own experiences to one another. At these sessions, women are enthusiastic about the research and their willingness to take part. This enthusiasm needs to be nurtured in order to encourage women to take part in the research and see it through to completion. Perhaps it is during these sessions that we should seek to break down the

stigmatised view of menstruation and highlight to our participants the positive aspects of their menstrual cycles. We are currently arranging a series of focus groups to discover why students are failing to complete menstrual cycle studies. These sessions will be recorded, but will be informal and relaxed in the hope that we can recreate the enthusiasm shown at recruitment sessions. In addition to exploring these young women's personal experiences of menstruation we hope to explore any further issues the women may have about taking part in such studies.

To conclude, we have considered some of the challenges faced when recruiting female students to take part in menstrual cycle research. While this can be problematic, undergraduate psychology students should provide an excellent population for recruitment. The challenge is not only to recruit large numbers of women, but to find a way to maintain their interest for the duration of the study, even when no incentives are offered. We argue that a more positive approach towards the menstrual cycle should be fostered among both researchers and participants if this is to be achieved and feel, in our experience, that focus groups could aid this process.

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1.2 Submitted Paper 2015 (Currently under review)

Menstruation: The Good the Bad and the Bloody

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[7679words]

Abstract

Dwelling on the problematic aspects of the menstrual cycle is typical in this field of research (Baca-Garcia et al., 2010; Natale & Alberatazzi, 2006), particularly the negativity women often express towards it (Jackson & Falmagne, 2013). Biopsychosocial models suggest that as well as biological influences, environmental and social factors strongly contribute towards these attitudes. This means that as well as peer group and family influences, the way in which the researcher contextualises questions can clearly influence participant responses. Although many feminist researchers attempt to highlight positive associations (Marván, Vazquez-Toboado & Chrisler, 2014; McPherson & Korfine, 2004; Lee, 2008), women still remain predominantly negative about their experiences (Johnston-Robledo & Chrisler, 2011; Kama & Barak-Brandes, 2013). As menstruation research has elicited both positive and negative attitudes, and most researchers usually focus on one of these, the current study specifically set out to take a balanced approach regarding the valence of womens' experiences. This study examines attitudes of young undergraduate females towards the menstrual cycle, exploring the emotional context they ascribe to these experiences. Twenty-two women responded to a series of semi-structured questions investigating feelings and attitudes towards the menstrual cycle. Thematic analysis suggested three main themes (The good: Positive aspects of menstruation; The bad: Shame and embarrassment and The Bloody: Menstruation is disgusting). Narratives reveal although young undergraduate women did express some positive attitude towards their menstrual cycle, negative and cultural based stereotypical attitudes predominate.

[233 words]

Keywords: Menstruation, natural, positive, shame, disgust

Introduction

Negative attitudes towards the menstrual cycle have been frequently portrayed. Historical evidence from carvings, papyri and scrolls and the bible offer evidence that menstruating women were shunned and thought of as unclean (for a review, see McAra & Wright, 2011). This type of negative portrayal is not limited to ancient times and research into the menstrual cycle continues to focus predominantly on the negative impact women are reported to experience (for example see Jackson & Falmagne, 2013; Natale & Alberatazzi, 2006). However, some researchers take a more positive approach in the language they use when talking about cyclic changes, with the focus on peak performance or "Cognitive Enhancement" rather than reduced performance or "Cognitive Decline" (Hampson, 1990). Others note that if women regard menstruation as natural they are more likely to regard it more positively than other women (Tang, Yeung & Lee, 2003). At present, however, much of this research has been limited in scope and often specific to a particular group. For example, only carried out with adolescent girls (e.g. Burrows & Johnson, 2005; Stubbs, 2008; Tang et al., 2003), women who suffer from premenstrual syndrome (Read, Perz & Ussher, 2014) or examining in the context of menstrual suppression (Johnston-Robledo, Ball, Lauta & Zekoll, 2003). There are few studies predominantly examining feelings and attitudes towards menstruation in young female adults, consequentially the current study will focus on a contemporary examination of these attitudes.

The context of this type of research is important, as research participants have been reported to express surprise when 'unexpectedly' asked about positive aspects of their menstrual cycle (Choi & McKeown, 1997). The link between menstrual cycle and both mood and cognition has been extensively examined, for example arguing that certain cycle phases can result in detrimental changes in cognitive performance (Wright & Badia, 1999) and for emotions, linking phase to negative affect (Natale & Alberatazzi, 2006).

With this type of focus being typical across a lot of research, it is evident that a literature search is more likely to retrieve articles reporting negative aspects of menstruation than those reporting positive influences (Hampson, 1990; Lee, 2008; Marván, Vazquez-Toboado & Chrisler, 2014; McPherson & Korfine, 2004; Tang et al., 2003) and the evidence suggests many women are negative about their experiences.

A biopsychosocial model suggests that biology is not the sole factor influencing attitudes towards menstruation (Mohamadirizi & Kordi, 2013). Women are influenced by social and environmental factors such as interaction with friends and family, as well as psychological factors such as anxiety and stress. These factors can influence how women perceive themselves and their bodies, which in turn, may influence their attitude towards menstruation. Expectations and attitudes towards menstruation are influenced not only by a woman's own expectations, but also the expectations of others (Stanton, Lobel, Sears & Deluca, 2002). For example, expectations can be influenced by media and advertising (Chrisler & Levy, 1990; Coutts & Berg, 1993), and can also be influenced by friends and family (Wilson, Turner & Keye, 1991; Fugate Woods et al., 1998).

As well as this, the tools a researcher employs can influence attitudes. Questionnaires such as the Menstrual Distress Questionnaire (MDQ, Moos, 1968), and the Menstrual Attitude Questionnaire (MAQ, Brooks-Gunn & Ruble, 1980) focus predominantly on negative aspects of the menstrual cycle (Delaney, Lupton & Toth, 1976; Ussher, 1989) and thus set a more negative tone to the research. Women asked to complete these measures are favourable towards menstrual suppression compared with women who complete questionnaires with a more positive focus (Aubeeluck & Maguire, 2002; Rose, Chrisler & Couture, 2008). Some suggest that even the title of a questionnaire can prime a negative response (Marván, Ramirez-Esparza, Cortez-Iniestra & Chrisler, 2006; Rose,et al., 2008). Conversely, Delaney et

al. (1976) took a positive stand, developing a new questionnaire called the Menstrual Joy Questionnaire (MJQ) asking women about their menstrual experiences within a positive context. As a result, when Chrisler, Johnson, Champagne and Preston (1994) asked women to complete the MJQ they found that asking about positive features elicited more positive attitudes towards menstruation. Stubbs and Costos (2004) argue that if positive attitudes are promoted in women this should unite women and may lead to them becoming more accepting of themselves and of their bodies.

It is therefore the case that a high proportion of previous research has been conducted within a framework that takes a largely negative view of the menstrual cycle in terms of both the questions posed about, and the very nature of menstruation itself. Although some studies have touched upon a more limited number of positive aspects (Burrows & Johnson, 2005), these have also generally taken an overall positive approach. This means that the majority of research has been framed either in a positive or negative context, rather than taking a more rounded view that it may contain elements of both. Thus, a main aim of the current study is to take a balanced approach regarding the valence of women's experiences of the menstrual cycle.

In terms of how best to do this, qualitative methods have been shown to be successful in encouraging women to talk frankly about their experiences of menstruation. Narratives bring insight into views on, and experiences of dealing with, menstruation in social settings (Allen & Goldberg, 2009; Burrows & Johnson, 2005). In a recent study, typical of this methodology, young US women were interviewed and asked about their personal experience of menarche (Jackson & Falmagne, 2013). Responses indicated that these young women recalled menarche as something unpleasant, which then influenced their feelings in later life leaving them with a negative attitude towards menstruation. Even though it explored young women's memories of menarche, several other themes emerged such as discussing how they

concealed their menses, using euphemisms when discussing menstruation and considering their experiences as 'suffering'. Although the framing was somewhat negative, Jackson and Falmagne (2013) do provide support for arguing that this type of research method can generate interesting data, and should provide a suitable general approach for the current project. Furthermore, focus groups provide a relaxed environment where women can interact and share their experiences of menstruation (Burrows & Johnson 2005; Settles, Pratt-Hyatt & Buchanan, 2008). A naturalistic setting shifts the power away from the researcher to the participant and can provide insight that might not otherwise be found (Wilkinson, 1999). This also allows for an examination of how women's attitudes to menstruation can be influenced by others.

In sum, the present study will take a balanced approach (encapsulating both negative and positive aspects) when examining attitudes towards the menstrual cycle in a group of young adult women, using the focus group method. It will use a series of semi-structured, open-ended questions about their attitudes and experiences relating to menstruation.

Method

The focus group method was chosen to simulate everyday conversations to explore how women create meaning and how they reach an understanding when in a group setting (Wilkinson, 1999). The aim here was to stimulate conversations which felt natural so those taking part were more likely to discuss and share personal experiences candidly.

Participants and Recruitment

Women over the age of 18 years studying at a Scottish university were invited to take part. Participants were recruited via advertisements and small group teaching sessions. In order to avoid discomfort and to put participants at ease groups were made up of friends and classmates. Over eight sessions a total of 22 women ranging in age from 20 – 43 years (mean 26.9 years) took part.

Procedure

Focus groups comprised of three or four respondents situated in a quiet lab with one of the researchers (NM) acting as facilitator. Sessions were video recorded using a wall mounted camera (Panasonic Network Camera Recorder with Viewer Software – Single Camera Version 3.06RO1) and digital voice recorder (Olympus WS - 450S). Participants were seated in comfortable chairs surrounding a low table, in order to create a relaxed atmosphere. The facilitator explained the aim of the sessions and reminded participants the sessions would be recorded but that data would be anonymised following transcription. At this point participants were reminded that they could choose to leave at any time without question. The facilitator introduced herself and invited participants to do the same before the first of three open-ended questions was asked, these can be found in Table 1.

Table 1

Questions asked in focus group sessions

Open ended focus group questions
1. Some people regard menstruation in a negative way. Can you tell me about any aspects of your menstrual cycle that you think of negatively?

2. *What aspects of your menstrual cycle can you think of that are positive?*

3. *How do you feel about discussing your menstrual cycle in this type of setting?*

The method and order of questions was decided based on suggestions made by participants in an earlier study examining reluctance to participate in menstrual cycle research (McAra & Wright, 2011). Additionally during each session the facilitator shared a personal experience of menstruation as suggested by Burrows and Johnson (2005). The intention here was to make participants feel more comfortable sharing their own experiences and this was done when women were reminiscing about school or when there was a break in conversation.

Analysis

Data were analysed thematically following suggested guidelines by Braun and Clarke (2006). Following verbatim transcription of all sessions, respondents' initials were replaced with a pseudonym. In the first instance, narratives were closely read without taking notes in order to allow the researchers to get a feel for the experiences of the women. Transcripts were then read several more times before initial coding was carried out with passages of speech extracted for coding. The extracted passages were then scrutinised to identify themes. Similar to other narrative research on menstruation carried out with adolescents (Burrows & Johnson, 2005; Jackson & Falmagne, 2013) the three overarching themes initially identified were positivity, negativity and disgust. These themes were then examined again and in each theme, narratives that directly used the theme name or a derivative were identified. A further examination was then made to identify where synonyms were used and these narratives were included for further analysis. In the Disgust theme for example, the words including grotty, dirty and yuck were considered to relate to disgust although this was dependent on the context within which the word was used. If these words had been used out with the context of menstruation they were omitted from further

analysis. The data were systematically examined and reviewed by one other member of the research team then discussed by all authors at length. Once this was completed the themes and subthemes were named before being interpreted. (Burrows & Johnson, 2005)

Table 2

Themes identified from the analysis

Themes	Subthemes
The Good: Positive aspects of menstruation	Fertility and reproductive health
	Natural and normal
	A good excuse
	Positive physical changes
The Bad: Shame and embarrassment	Concealment then and now
The Bloody: Menstruation is disgusting	Disgust of blood
	Disgust of others

Findings

The Good: Positive aspects of menstruation. When asked to consider positive aspects of their menstrual cycle women often spoke about how menstruation was indicative of good reproductive health.

Fertility and reproductive health: Women were asked to consider what they perceived as positive about their menstrual cycle. The term 'positive' itself, however, may be misleading in this context when what researchers are looking for is a reduction in negativity in how the topic is approached. Rather than regarding menstruation as completely negative and shameful researchers hope to encourage women to accept it as a natural part of their lives and move focus away from shame and embarrassment. When

asked about positive aspects of their menstrual cycle the tendency is for answers to be related to fertility or reproductive health (Burrows & Johnson, 2005). Indeed, when asked about the positive aspects of menstruation, most responses did relate to these.

> **Amanda** well if you're having a period then it means everything's…it's all working isn't it? … Everything's still going…you're still quite healthy…
>
> **Lauren** lets you know you're fertile [laughter from group]
>
> **Stephanie** it's good to know that things are in working order at times as well…you know when you get that thing of..."oh it's two days late…oh my gosh" and then you get it and you're like "phew"…

Several women in the groups associated monthly bleeding with reproductive health showing what seemed to be some confusion between what ovulation and menstruation mean. Indeed, for many of the women this 'sign of fertility' was what they regarded as the only positive aspect of their menstrual cycle.

> **Laura** yeah you can have babies
>
> **Mary** well you know handy its…in that you know you can have kids if you want
>
> **Hannah** definitely the good thing about periods is you know you're not pregnant [laughter and agreement from the group]
>
> **Hazel** I like the thought of knowing I'm not pregnant [laughing]…just that little extra precaution

Hannah definitely the good thing about periods is you know you're not pregnant [laughter and agreement from the group] …so happy when it comes…you're like [raises fist in a victory gesture]

Stephanie it's good to know that things are in working order at times as well…you know when you get that thing of..."oh it's two days late…oh my gosh" and then you get it and you're like "phew"…

Chloe well I suppose a positive thing is that you can have children…you know you're getting a period you're getting a proper…[gestures in circular motion] and you want children, that's a positive thing … then you know that at one point if you want to …well hopefully if there's no complications and stuff

Janet It shows you have a healthy reproductive system and you're not pregnant!

Sharing misconceptions about menstruation can lead to a distortion of the link between menstruation and pregnancy (Moore, 1995). In focus groups where females stated menstrual bleeding was a sign of reproductive health, there was broad agreement from the others in the group. It is unclear why some females hold the belief that menstruation itself indicates fertility but some mothers at menarche tell girls that now they are menstruating they can become pregnant and it may be that this is misinterpreted. If no reference is made to other phases of the cycle e.g. ovulation, they may lack a complete understanding of what the menstrual cycle entails.

Increasing numbers of women using hormonal contraceptives are now seeking to reduce or suppress their menses. This is particularly common in Europe and the USA with many women expressing a preference for suppressing menstruation completely (Hitchcock & Prior, 2004; Andrist, et al., 2004; Kantartzis & Sucato, 2013; Lakehomer, Kaplan, Wozniak & Minson, 2013). Although some women taking

part in the focus groups indicated that they use menstrual suppressing contraceptives, others welcomed their period.

Kate It reassures me that I'm not pregnant, also a sign of an unstable period could be worrying so I'm happy I get them every month.

Anne yeah and as soon as I get them I'm so happy it's unbelievable… because it's just like…it's just like that, relief [agreement from group]

Natural and normal: Some women also referred to menstruation being a natural and normal function women experience and as such something, that should be regarded positively. This supports the suggestion that regarding menstruation as natural will encourage a more positive attitude towards it (Tang et al., 2003).

Laura I like to have my period…because I just feel like its natural it's something like… I feel like every time my blood comes I feel like I'm clean inside…so your period or the time that you have blood…the opposite time of the month is when we are…when we are ready…I feel more lovely…more much more…my husband when he comes I feel…you know I think if we didn't have the period then we would feel the same all month you know…

Sophie A menstrual cycle is a healthy and normal part of life as a woman. Normal/regular menstrual cycles indicate no hormonal problems (such as PCOS or endometriosis) and therefore should be viewed as positive.

Amanda Yes, it meant you were a fully functioning normal woman.

Shona The natural process impact on physical health it's all positive as it is a sign you are healthy.

A good excuse: For some participants a positive aspect of menstruation was being able to avoid sex and typically this comment brought laughter and agreement from the others in the groups. For many women this is a common excuse for avoiding sex and is regarded as a legitimate reason for abstaining (Delaney et al., 1988; Thornton, 2013).

Molly you get out of sex [laughter from group]… absolutely…it's always the favourite excuse isn't it? Nah I can't… [more laughter]

Lauren a good excuse sometimes [laughter from group] **FACILITATOR** so avoiding sex? **Lauren** …yeah. **Elisabeth** yeah … that is a good excuse

Denise An early night! No expectation of sex!

Positive physical changes: For some of the women, the positives they enjoyed related to physical changes in their bodies over the menstrual cycle and these suggestions were very animated with several women in the group in agreement with the speakers.

Anne yeah cos even clothes… I can go and like get new clothes

June you feel skinnier [agreement from group]…you get skinnier because you know you're get bloated and you start thinking I need to go to the gym then you get your period and you're like well no I'm fine…[laughter]

Elisabeth yeah your stomach goes quite flat …yeah and your boobs get bigger [laughing]…they do

Kate erm…this is silly…but erm …right…right beforehand…before I start my period I maybe eat more you know chocolate and stuff…but see like in that actual week like,…I don't think I eat as much. Well I feel like I don't eat as much…I think it's maybe the bloatedness [sic] goes away or something yeah but I always feel a bit better

In all of the sessions there was a long pause before anyone responded to the question which may indicate surprise at being asked to consider positive aspects (Choi & McKeown, 1997). Previous research suggests that adolescent girls can hold both negative and positive views of menstruation but this depends on how their mother prepared them for menarche (Kissling, 1996). Feminist researchers, however, argue that the negative construction of menstruation discourages the discussion of positive characteristics of menstruation (Marván et al. 2006). This was evident in the focus group sessions and when no positive aspects were mentioned conversation tended to focus on perceived negatives. This also fits with the biopsychosocial approach which suggests that attitudes towards the menstrual cycle will be influenced by the attitudes of others (Stanton et al., 2002). When positive comments were made they were often only discussed briefly, and if others in the group did not share a positive attitude discussions reverted quickly to perceived negative aspects of menstruation.

The Bad: Shame and embarrassment. Many of the women discussed the embarrassment they felt in relation to different aspects of menstruation. Several women also discussed details of how they managed their menses, keeping them hidden from others.

Concealment then and now: Several women discussed their experiences in dealing with menstruation when they were younger. Narratives about school centred on the practices used to keep menstruation private and these practices continue into adulthood (Simes & Berg, 2001; Erchull et al., 2002; Burrows & Johnson, 2005; Jackson & Falmagne, 2013). The concealment of menses and the embarrassment likely to be experienced had others (boys and girls) seeing evidence of menstrual blood were widely discussed. The most common word used to describe these feelings was embarrassment although words such as mortified or horrified were also used to convey embarrassment.

> **Chloe** …yeah is it going to show through your clothes and that? [Agreement from group]. Now I wouldn't bother…now I'm not so worried…but when you were...when you first started then that was a huge…
>
> **Hannah** and **Amy** [together] yeah
>
> **Chloe** …worry
>
> **Hazel** you know what it's like…see even in high school when you got caught out and you went to the office…you were like slipped something so…so slyly it was…what…you know it's not like people don't realise why I'm here…you know what I mean?...
>
> **Elizabeth** oh my God…I did that when I was at school…I got up and it was on the chair…I was mortified…I don't think anybody noticed … but I was mortified
>
> **Hazel** it's just as bad sometimes when you get caught out though…just like in your pants cos…

For many participants school was where the secret really needed to be kept and a number of lengthy conversations emerged about how this was managed. Adolescent girl's attitudes towards menstruation

tend to be negative (Koff & Rierdan, 1995; McPherson & Korfine, 2004) and the shame of being 'discovered' does not appear to reduce with age. Menstrual products may be advertised overtly but the products are designed to keep menstruation hidden (Chrisler, 2011; Chrisler & Levy, 1990; Kama & Barak-Brandes, 2013; Jackson & Falmagne, 2013) something that remains a priority for women.

> **June** …and you know what I do? I…this isn't…I wear two pairs of knickers...so I have one with the pad on and then another pair of knickers to keep it all in place cos it moves around too much if I don't …and I know it sound ridiculous but then also what I do is that I put an extra pair of knickers on over tights to make sure the tights stay up cos I hate it when they go down…so if I've got my periods and I'm wearing a skirt, I've got three pairs of knickers [laughter from group] so if I get hit by a bus I'm like well what will they think…[laughter from group]…so yeah…that aspect of it. But it just makes me feel safer you know. I'm all contained…all contained, so if it leaks, I have it all…you know I have an extra layer before there's a disaster… [Laughter]

Despite the laughter there was broad agreement with the measures taken and the use of the word *disaster* here indicates just how strongly this participant feels about concealing her menses. This shame may seem extreme however people have been shown to react negatively towards menstruating women (Roberts, Goldenberg, Power & Pyszczynski, 2002). Additionally, menstruating women have been rated as more neurotic, more irritable and sadder than non-menstruating women (Forbes, Adams-Curtis, White & Holmgrem, 2003). This type of negative stereotyping may contribute to why some women feel shame and embarrassment in relation to their menstrual cycle.

The Bloody: Menstruation is disgusting. This theme represents the phrase that was most commonly used by females when asked about menstruation. This includes the elements that females most commonly considered made them feel disgust and overwhelmingly this was associated with menstrual blood.

One of the most common negative terms used by women to describe their experience of menstruation was disgust. This was directly expressed with many women actually using the word disgust, and indirectly when women talked about how menstruation made them feel disgusted because it made them feel dirty. Gender differences in disgust sensitivity have been reported with women being more sensitive to disgust than men (Borg, Lieberman & Kiehl, 2008; Haidt, McCauley & Rozin, 1994; Holstermann, Ainley, Grube, Roick & Bögeholz, 2012; Rohrmann, Happ & Quirin, 2008; Skolnick, 2013; Skolnick, Bascom & Wilson, 2013) and this may be a contributing factor in the focus of much of the discussions. Typically, one woman would say something about disgust and the other women in the group would agree and again this fits with the biopsychosocial approach. The conversation would then move to why women felt it was disgusting or women would describe an experience related to menstruation that they felt made them feel as if they were disgusting.

> **June** it's just disgusting in that respect…and there's always one pad that you haven't put on quite right [Agreement from group].
>
> **Stephanie** I guess it's that kind of wanting to fit in with everybody else and not really be embarrassed or be…be disgusting or anything like that and I think that's where the line gets drawn really [Agreement from group]..

Disgust of blood: Evidence suggests both men and women openly discuss feelings of disgust relating to menstrual blood (Thornton, 2013) and such feelings were discussed in several of the sessions. Women's narratives about menstruation often relate to menstrual blood itself with fear expressed that it might leak through their clothing leaving (Oxley, 1998).

> **Hazel** sorry …that's totally disgusting…I don't think it's like real blood …well it is cos it's blood obviously
>
> **Elizabeth** … clots…is it not more lining?
>
> **Hazel** yeah…sticky and…
>
> **June** It does make you feel grotty. You know you feel like you're dirty all day. [Agreement from group] you know you have a shower in the morning and in the evening and you can still feel pretty dirty and it's just disgusting in that respect…
>
> **Denise** dirty…disgusting…
>
> **Elizabeth** dirty…disgusting… no…I think it's really unhygienic …

The disgust women mentioned was not always felt personally and for some participants expressed their perception that men are disgusted by menstrual blood. Cinema and television often portray menstruation in a negative manner with both the big and small screen using it for comedic purposes. In the cinema, menstruation has also been portrayed as something that can be horrific for young girls in films such as Carrie (De Palma, 1976). This type of portrayal may help explain why for some of the women there is a belief some men are disgusted by menstrual blood. Some women perceive menstrual blood as unnatural and different from venous blood consequently strengthening the perception that it is dirty and should be

hidden (Johnston-Robledo & Chrisler, 2011; Kama & Barak-Brandes, 2013). One participant discussed her partner's reaction to her menstrual blood.

> **Lesley** right…like if I like say just cut myself on my arm…my boyfriend can look at the blood on my arm … but if its blood down there he's like yuck yeah…it's just the same blood…so
>
> **Laura** I think they think that the blood is…the blood is mixed…mixed with something that is like …like rest…or you know wastes [sic] or something like that…

Disgust of others: The perceived disgust of other people was often discussed and the "others" participants were concerned about included both men and women and comprised of friends and colleagues. When talking about menstruation and school, "others" are often class mates (men & women) but when talking about adult experiences "others" tend to be men friends or acquaintances. Johnston-Robledo and Chrisler (2011) note that although society generally no longer regards menstrual blood as toxic, *good manners* dictate it should be concealed in public and in private.

The disgust surrounding menstrual blood was also referred to in sessions where women talked about sex during menstruation. Many women describe menstrual sex as messy and disgusting, or unhygienic in relation to menstrual blood, while others abstain due to embarrassment about their body when menstruating (Fahs, 2011).

> **Lesley** mm yeah and no…I mean there's been times when…I only see my boyfriend at the weekends because I'm here [university] …I met him when we were back home…and if I'm in the mood you know and I'll say to him can you do something and he's like [screws up face with look

of disgust] but you're bleeding and I'm like "so, it cleans" but he's like…he just thinks it's disgusting going anywhere near me down there when I'm bleeding.

Laura it's so funny… when I met my husband…when we were just going out erm…he didn't mind to have intercourse with me when I had my period but nowadays…he can't even see…when he perceives that I have my period he feels like when he goes to the toilet he never open the bin because he finds something over there that's red…it's so funny how he changes… I ask him the other day…why do you change because…when I have my period I'm also feeling...you know and he's always saying…no, no blood…but you used to like!... you didn't mind before. Why is that now? No, no, no it's just disgusting; he can't even say why

For this couple, prior to marriage, sex during menstruation was initially enjoyed by both participants, yet the men now avoids it and cannot, or will not, say why. Young college women reported trying menstrual sex but found the experience unfavourable citing factors such as discomfort, messiness, or that they felt it was unsanitary (Allen & Goldberg, 2009; Fahs, 2011). Men who had experienced menstrual sex stated they had been put off future attempts by the mess, while those who had not experienced menstrual sex also cited the mess as a deterrent (Allen & Goldberg, 2009).

In the focus group sessions one woman discussed a male friend who claims a menstruating woman can be identified by smell. She found this disgusting and felt she should avoid him when she is menstruating even though she is unsure if she actually believes him. Although the evidence for sex differences in odour detection is conflicting, females are thought to outperform males for detection and identification of odours (Doty & Cameron, 2009). Perhaps in this case it is the woman's own sensitivity to odour that causes her to question whether this male can detect her menstruation.

Elizabeth well I've got a guy friend who says he can smell when a woman's on her period … yeah he says he can always tell when my female friends are on their period … and that's like that's disgusting…so I don't like seeing him

In an analysis of Tweets relating to menstruation spanning the course of one week in 2010, clear evidence of negative stereotyping was found. Twitter provides a forum where anonymity and freedom of expression allow for discussion on topics often thought of as taboo. Thornton (2013) examined Tweets to explore whether negative stereotyping related to menstruation continues and explored how the meaning of menstruation is constructed within the forum. Negative stereotyping towards menstruating women in general and specific Tweets relating to why menstruating women should mask their scent were common. These were not confined to men contributors with many women also tweeting about the need for menstruating women to mask their scent. Again this suggests that women may be influenced by the attitudes and beliefs of others and this is evidenced by their agreement with negative statements relating to menstruation.

Discussions about menarche tended to be neutral or negative across the sessions. Attitudes towards the menstrual cycle can be influenced by the way a mother deals with her daughter at menarche (Costos, Ackerman & Paradis, 2002; Lee, 2008; Marván & Molina-Abolnik, 2012; Ozdemir, Nazik & Pasinlioğlu, 2010; Stanton et al., 2002). Studies from the 1970's and 80's examining the role of mothers at menarche found young girls were encouraged to feel shame and embarrassment in relation to their menses (Delaney, et al*.,* 1976; Golub & Harrington, 1981). More recent evidence suggests emotionally engaged and supportive mothers can encourage more positive attitudes towards menarche and menstruation in their daughters (Beausang & Razor, 2000; Lee, 2008). This was not evident in focus group narratives as

one participant explained. Her feelings of disgust prevented her from telling her mother her period had begun and she states her mother "found out" rather than being told.

> **Chloe** and erm…it was the most horrible disgusting thing and I was greeting [crying] in the toilet and stuff…and I think I had at least two [periods] before I…or even three and then she found out…

Limitations

Asking women to split experiences of menstruation into positive and negative has been criticised as simplistic (Burrows & Johnson, 2005), and it may be that the manner in which women are asked about menstruation primes their response. The current attempted to be consistent, by ensuring that in each session negative issues were raised first and this was done with the belief that this would provoke an initial response and therefore encourage discussion across the whole session. The strategy was certainly successful in terms of provoking discussion; however, this may have been naïve in terms of achieving the aim of exploring both aspects and may have acted as a prime that made women focus much more on their negative experiences (Rose et al., 2008). On reflection, it may have been judicious simply to ask participants to relate their experiences without making any reference to the terms positive or negative. Qualitative methods may be useful for gaining insight into women's perceptions of menstruation but future research should consider the best way to initiate the conversation in order to avoid narratives becoming unduly biased.

Conclusion

It seems that for some of these young women, menstruation remains something they tolerate and which remains for them, a predominantly negative aspect of womanhood (Jackson & Falmange, 2013). The findings are somewhat mixed, as while some women continue to hold a negative and mainly stereotypical view of menstruation (Thornton, 2013), others also hold positive attitudes towards their menstrual cycle. As would be predicted from a biopsychosocial model, the social context can certainly influence expressed attitudes. For example, when the majority in a group hold negative attitudes, it becomes difficult to elicit positive responses. It was also the case that positivity was expressed far less often that negativity in some of the sessions but there was a clear agreement amongst the women that signs of fertility are certainly a positive aspect. A good example of this is where one woman when asked what was positive about her menstrual cycle, responded emphatically stating "All of it! Without it reproduction would be impossible in a natural way". Her comment was met initially with silence before another woman responded negatively, telling the group she hated everything about her menstrual cycle. This was met with agreement from others in the group and the conversation quickly returned to discussing what the women perceived to be negative about menstruation.

Approaching menstruation with a positive attitude as a researcher may not be sufficient to evoke positivity about menstruation in women. If women expressing positive attitude are not encouraged or supported by others in the group they quickly stop considering what might be considered positive. Negative stereotypical views seem more likely to be the view that women can relate to when discussing the menstrual cycle. In keeping with the biopsychosocial approach, narratives were influenced by the shared experiences of others in the groups. Women who were describing positive experiences of the menstrual cycle may have found it difficult in a group setting to contradict the majority opinion. This may cause

them conform to the majority view which reinforces the belief that menstruation is inconvenient, embarrassing and disgusting.

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Appendix 2.0

2.1 Female Focus Group Questions

Today we are here to talk about something that we all have experience in. Before we get started I'd like to say a few things. Firstly, this session is being video recorded so that I can refer back to it when I transcribe our discussions. If anyone is uncomfortable with that please say so and of course you are free to leave if you wish. Once we get started please do speak up and as much as possible can we try to have one person at a time talking? Please do feel free to say exactly what you think and don't worry about what anyone else might think. We are all here to share our opinions and have fun while we do that. Why don't we start off by introducing ourselves? Own research here…

1. Some people regard menstruation in a negative way. Can you tell me about any aspects of your menstrual cycle that you think of negatively?
    a. Why do you think of that as a negative thing?

2. What aspects of your menstrual cycle can you think of that are positive?
    a. Why do you think of that as a positive thing?

3. How do you feel about discussing your menstrual cycle in this type of setting?
    a. Why do you think that is the case?
    b. Are there any settings you would feel more comfortable in?
    c. Are there any settings in which you would feel uncomfortable talking about your menstrual cycle?
    d. Can you explain why this would make you feel uncomfortable?
4. Have you ever been asked to take part in any research examining the menstrual cycle?

a. Can you explain why you were happy to take part
    i. Did you complete the study?
    ii. If not, are there specific reasons you did not finish the study?
    iii. Can you expand on these?
b. Can you explain why you choose not to take part
    i. If the length of the study was a factor, can you explain why
    ii. If you felt embarrassed about taking part can you explain why?
    iii. Is there anything that would have encouraged you to take part?

5. I am currently running a study which asks participants to complete a menstrual chart for 3 full cycles and to use ovulation kits for 8 days in each of the cycles. I have found that participants are reluctant to take part or that they agree to take part then do not complete the study. I would be interested in hearing why you think women are reluctant to take part and if there are any aspects of the study that you think may be at the root of the reluctance.
    a. How do you think the length of the study influences participation?
    b. How do you think the use of ovulation kits influences participants?
        i. How would you feel if you were asked to use ovulation kits?
        ii. Can you think of any problems using ovulation kits might cause you?
        iii. Can you explain why?

6. Do you have any suggestions as to how women might be encouraged to take part in research into the menstrual cycle?

7. What would encourage you to take part in this type of study?

2.2 Male Focus Group Questions

Today we are here to talk about something that we all have experience in. Before we get started I'd like to say a few things. Firstly, this session is being video recorded so that I can refer back to it when I transcribe our discussions. If anyone is uncomfortable with that please say so and of course you are free to leave if you wish. Once the conversations are transcribed the data will be anonymised. Once we get started please do speak up and as much as possible can we try to have one person at a time talking? Please feel free to say exactly what you think and don't worry about what anyone else might think. We are all here to share our opinions and I value your opinion. Why don't we start off by introducing ourselves?

1. How did you first learn about the menstrual cycle?
    a. Was it something you discussed with male friends?
    b. What about female friends?
    c. What about family?

2. Can you tell me about any aspects of the menstrual cycle that you think of negatively?
    a. Why do you think of that as a negative thing?

3. Many women believe men view menstruation in a negative way. Why do you think that is the case?
    a. Do you think you are unsympathetic?
    b. Why is that the case?

4. Many women describe menstruation as disgusting. Do you agree with this?
    a. Can you explain why you feel that way?

5. **Some women believe that men are disgusted by a menstruating woman. Do you think this is true?**
    a. **Why do you think that?**

6. Can you think of any aspects of the menstrual cycle that you would regard as positive?
    a. Why do you think of that as a positive thing?

7. How do you feel about discussing the menstrual cycle like this?
    a. Why do you think that is the case?

b. Are there any settings you would feel more comfortable in?
c. Are there any settings in which you would feel uncomfortable talking about your menstrual cycle?
d. Can you explain why this would make you feel uncomfortable?
e. Is there anyone you would not discuss the menstrual cycle with?
f. Why not?

8. Can you explain why you were happy to take part in this group?
    a. Do you think men's views about menstruation are important?
    b. If you felt embarrassed about taking part can you explain why?

Adapted questions for online Questionnaire

1. How did you first learn about the menstrual cycle?
2. Was it something you discussed with male friends?
3. What about female friends?
4. What about family?
5. Are there any aspects of the menstrual cycle that you think of negatively?
6. Why do you think of that as a negative thing?
7. Many women believe men view menstruation in a negative way. Why do you think that is the case?
8. Do you think you are unsympathetic?
9. Many women describe menstruation as disgusting. Do you agree with this?
10. Some women believe that men are disgusted by a menstruating woman. Do you think this is true?
11. Can you think of any aspects of the menstrual cycle that you would regard as positive?
12. How do you feel answering questions about the menstrual cycle?
13. Are there any settings in which you would feel uncomfortable talking about the menstrual cycle?
14. Is there anyone you would not discuss the menstrual cycle with?
15. Can you explain why you were happy to take part in this study?
16. If you felt embarrassed about taking part can you explain why?
17. Do you think men are unsympathetic?

2.3 Sample Focus Group Transcript

Complete transcripts can be found on CD rom

FACILITATOR: Today we are here to talk about something that we all have experience in. Before we get started I'd like to say a few things. Firstly, this session is being video recorded so that I can refer back to it when I transcribe our discussions. If anyone is uncomfortable with that please say so and of course you are free to leave if you wish. Once we get started please do speak up and as much as possible can we try to have one person at a time talking? Please do feel free to say exactly what you think and don't worry about what anyone else might think. We are all here to share our opinions and have fun while we do that.

FACILITATOR Some people regard menstruation in a negative way. Can you tell me about any aspects of your menstrual cycle that you think of negatively?

NB All of it

FACILITATOR: All of it? Ok

NB it's just a nightmare and well personally, well my symptoms have got much worse…as I got older... I had [names son] at 33, so I think that since I got to [names son] that…cos my symptoms got so bad that my doctor thought I was going through the change of life and tested me… but nut, it's just that I'm getting more and more symptoms. So when I go she sort of keeps a diary thing and she goes "well what have you got now?" and I'm like "something else" and it's just a nightmare

FACILITATOR So all kind of premenstrual related then?

NB Yeah and then basically then as soon as I get my period its such a relief because I know that that's…I'll maybe have a wee bubble that day or whatever but it's gone…it's not physical symptoms with

me, it's just like mental and emotional…[laughs]…my kids are like that "oh no here it starts again…" [Laughter from the group]…so…

CE I don't really experience any premenstrual pain at all… - yeah never really any problems with my menstrual cycle.

FACILITATOR so no negative feelings about it?

CE erm I think women are cursed… [Laughter from group] no , no really I do… I think that…that time of the month.. I really hate it, really hate it – the uncomfortableness of it, yeah

SH yeah, yeah, I'd be the exact same yes, I'd agree, yes women are cursed

CE and SH together – women are cursed

CE Men don't have this!

SH this is probably why they have to fight or go to war or something because they need some kind of balance. We have this… they need to have some..[inaudible]..no, no I'd agree, it's just an uncomfortable time of the month

CE yes

SH Yeah and hassle, yeah…like I don't think I have any major issues either but it is just a hassle and I think everyone finds it. You know cos it's out of your normal routine and everything and yeah…don't like it

MM Well at the moment my experience is quite different. I've been through the like.. you know… like you know…your age [laughter] and then like having kids, but like post children, you know it's quite you know, your sort of up and down moods… pain, it's awful, the whole eh the whole em thing and I actually found that at that time that I could have like 3 weeks worth of PMT…

NB Yeah that's me…

MM …you know and at some stages you're just actually not sure whether you're just going mad or you know this is actually hormonal. But at the moment I em, I don't actually em get regular periods cos I've got a Mirena coil and so…but what is really negative about it is that I don't know when I'm going to get a period at all and I don't know how long its going to last, I don't know anything about it so I got caught out [laughs] uh ha in St Andrews and I got caught out and it was like "noooooo" cos I don't carry things with me because it can be six months between…so yeah, so it's quite different. I don't get the mood swings quite as much with that either so yeah

SH I've never had that and it worries me greatly…

MM …mood swings?

SH …yeah, I've never had any PMS or anything like that

MM yeah I wonder if it's … personality linked [murmurs of agreement from NB and CE] or of some kind of trait…[laughter] no seriously or maybe people who are more susceptible to stress yeah or maybe a bit more, what's the word… on the personality trait scales…?

SH Yeah cos people have said to me…

MM …neurotic

SH … said to me that you can get it as you grow older…and you know seeing people suffering so horrendously I am concerned. I'm just praying that I don't experience that, like, yeah that you know it is a worry.

MM You're quite a. … stable kind of personality though aren't you?

SH I like that [laughter from the group]

MM …a kind of stable personality yeah

SH I'm stable

FACILITATOR always good to know [more laughter from the group]

MM she never comes in to the office you know ranting about something whereas I think… well no, no I don't think I've seen you either…come in ranting, I think the rest of us have.

SH [laughing]…she's building us up eh [laughter

FACILITATOR so that's quite interesting that everybody has negative aspects…lets turn it around a little bit. What about…can you think of any aspects of your menstrual cycle that are positive?

NB you get pissed really quick [laughter from the group]…well I do. That's a cheap night basically, no Noelle seriously no…I take a couple of drinks and I'm whoa, you know and I think I'm definitely PMTing because I know as soon as like just one or two drinks and I get that funny bubbly feeling in my face and that's it…you know cheap night tonight [laughter]…so that's one for me. It's not a…I'm laughing saying it's a cheap night, but yeah that is one thing yeah that I do get

FACILITATOR …that's a positive…?

NB …yeah and as soon as I get them I'm so happy it's unbelievable… because it's just like…it's just like that, relief [agreement from group]

MM yeah, yeah I would say that…yeah I think the positive is the re…the kind of almost like a release when you…

NB yeah cos even clothes… I can go and like get new clothes…I ran in to New Look just before Christmas, grabbed a couple of dresses, came home and was like… and I was saying [names son] pull the zip – this is my middle son – and he's like mum no way and I'm squeezing them in [squeezes breasts] and I took them on Christmas morning, I put my dress on and I thought nah…and when I put it on 2 days later it was actually hanging I could of got away with just wearing, so that's one thing that annoys me…if I go for clothes at a certain time then… I'm always that bit bigger…but then it's handy for when you are like PMTing if you wear them again cos like you're big [laughter]…it's just…it's mad

FACILITATOR Does anybody else have any kind of positives that they can think of? [Murmurs and laughter from group]... so do you think it's a totally negative thing then?

SH well you know handy its…in that you know you can have kids if you want to [more laughter]…but other than that no I wouldn't think of one positive thing

CE no.. I think… just a monthly reminder that you can still have kids

SH yeah, yeah, that's about it

FACILITATOR so do think that's about all it's good for then?

SH and CE yeah [laughter]

MM yes just to remind you that you're not pregnant [laughter]

SH that's true [laughing]

FACILITATOR there's a lot of stuff…I mean I did my first dissertation looking at PMS and I tried to look at it from a different point of view as well and there are some people who would say that that whole you know that feeling when you're feeling negative and you're shouting at the kids…you know PMS. You can turn that around, you know if you think about it in a slightly different way…is that it's not just that you're negative, you're actually happier at the same time, you're more aware… your senses essentially become heightened… your *happier* as well as being grumpier…

MM …yeah…

FACILITATOR …when you're happy, you're happier than you were, so it's kind of trying to put a positive spin on it. There are a lot of people who would argue that there are positives [laughter from group]...in the menstrual cycle.

I just want to change tack now slightly. How do you feel about talking about the menstrual cycle in a setting like this?

NB oh I've no problem talking about it like in a…cos I think it's something that I could…like a lot of times if I'm sitting speaking to people, I'll obviously, well I'll always think that everyone's opinion is better than mine, I know that I've not got a right opinion, but on this it's what's in here [points to chest] with me, so nobody can sort of say "no that's no right" cos I can say seriously, no it really is right. So I probably

feel more confident sitting talking about this cos its something that affects me so personally and it's no like something that you've read out of a book and I've no got the words that maybe all you have got or something like that whereas I can just say it like it is…a nightmare [laughter]… you know…so it's yeah…the thought of doing my presentation [4th year project presentation] sorry…oh Noelle that's killing me

MM but everybody's feeling like that

NB [names female lecturer] says it's ok and I'm like that…sweating every time I think about it

FACILITATOR but this is about the number of people who will be in the room when you do it.

NB I know but then it's like obviously there's going to be 2 lecturers like, kind of judging you…ooh

FACILITATOR it'll be just like sitting speaking to me and I'm a lecturer

NB I know I know, but then, but you're interested in this though cos even when we were in like [names a male lecturer] class and he was going about saying to everybody "what is it your doing?" and they're all reactions times and all this different … and he's like "and what are you doing?" and I'm like I'm on PMT and he's, and I don't know who's more…and me and him just kind of looked and he just went "ok good luck with that" and kind of looked away and I just kind of sat [laughter from rest of group] in the class and thought aw please dinnae ask me…aw but

FACILITATOR that's quite interesting as well you know that reaction that…

NB …yeah… like they're looking at you like that…

MM yeah specially males

FACILITATOR yeah a lot of people say that to me as soon as I say the menstrual cycle… and oh oh [laughter from the group] …so , so how do you think it would be for example if I brought men into this kind of setting?

MM phew I mean it dep…yeah I mean I wouldn't mind my husband obviously cos that's you know…I know him so that's not a problem. But I wouldn't be comfortable sitting divulging personal things.. I think with men that I don't know [murmurs of agreement from group]

NB well I think I in a way it would be a good thing to give them an understanding of how sort of bad or good things could really be. Cos a lot of men will be… och they blame it on PMT [murmurs of agreement] or och see even like see [names son] my oldest son, he's like "mum you're PMTing eh?" and I'm like "yeah definitely son" and he's like… he knows…they've known from they were small cos it has affected me so I always said like you know "I get woman's things" so it's just…so even just now, [names eldest son] going through this banging his feet and everything and I'm like "are you PMTing?" [laughter from group] and he' says "mum, you know sometimes I just get really angry" and I'm like "I think you're PMTing son". So do men get hormones as well?

FACILITATOR a lot of folk would argue that men have a cycle [chorus of yeah from group] that tends to be lunar rather than…

NB Well honestly, I think I can see that with my [names son], he's so chilled out and dead nice and then [pulls face] and I say oh you look like mum

FACILITATOR how old is he?

NB he's 20 on 25th February…so it's just…you're like…but yeah, no I can see him like me but no if it's just…as you say [directed to MM] it's just like personality types as well so…that could have quite a big bit to do with it, I don't know, but eh he's quite like me.

SH Most men are freaked out by it like…I guarantee if I went out and grabbed some young fella from the students union and said "lets talk about periods…" [laughter from group] they'd go white, they would.

FACILITATOR I think that's the case as well when you try to talk to them on their own, but I think that when I ask talk about my research in the classroom and I can get them to laugh about it and they seem to be quite comfortable with that. But I think it's if you single them out [agreement from group]

MM yeah, yeah, I mean.. I think I would be quite happy talking about, about periods in general [agreement]. I don't think I would be happy talking about personal issues [agreement] but that's…yeah, but talking about erm issues surrounding the menstrual cycle with men, you know I'm just…that's fine.

SH when I was in school we had a male teacher and someone got a ton of tampons eh opened them up and put them instead of chalk across the blackboard [giggling from group] and the guy walk... he's in his twenties and he walked over and you know he went to pick one up and he saw it, took his hand away and spent the next 2 hours standing in front of his desk [laughter]…instead of behind it near the blackboard…that if anything kind of exemplifies men's attitudes towards it [agreement and laughter from group]…if that was a woman they would just throw it out the side, find the chalk and keep going, but him no [laughter]

FACILITATOR that takes me back to being a child you know a little child and they used to have… you'll maybe not remember this yourselves but they used to ladies have little strings in the end [mimics putting mask over mouth] … [laughter from group]…when we were kids…ah well

NB pretend you were a doctor [more laughter from group]

MM it's those ones that you have to remember to pull the chords before you use it

FACILITATOR that's right

MM the amount of times you'd forget…that wasn't pleasant [more laughter]

NB my boys wouldn't be embarrassed about speaking about it because… I'm quite open with them about it so…but then I can understand like some men having a thing about it but…

MN why do you think it is then? Do you think it's because it's still treated like something that's entirely negative?

NB I don't know like I was a late like I was a 15 when I started my periods so… my mum died when I was 6 and my dad was basically a drunk right so it was my gran that did it. I remember saying to her [whispers] "gran I've started my period" and she was like "[name of respondent] dinnae tell me"…well who am I gonna tell? She went "fuck, tell [name]. So she was my sister so I was like "[names sister] I've

started my period" and she was like "what are you telling me for?" and I thought I was great… I was start…everybody had periods except me and I just wanted to "yeah I've started…" that never lasted long – that good feeling I'll tell you.[laughter from group] but then…and [sister's name] used these Bodyform and they were big so I used that and I used to say to my gran "gran I've got my period" and she'd be like "fuck does that mean I've got to go to the chemist for you?" she would get that nervous so from a young girl I was going and getting all my things so…

FACILITATOR how did you feel when you were going and buying them? Did you feel embarrassed by buying them?

NB I think I was just excited Noelle that I'd started, that's what it was and then I remember like trying Tampax and thinking "oh what!" and that was probably the worst thing in my life… and I worked in a playgroup at the time you know doing community work at school and the playgroup teacher [names teacher] came in and I was crying in the toilet because I just sort of couldn't do it and she was like "[name] wanting me to help?" and I was just like "no you canny, just tell us what to do and she's like "right just put your leg on the toilet and…[laughter from group] and I just couldnae dae it and obviously it wasn't in right and it was dead sore and I couldn't sit down and I was walking around like [stands and mimics walk] do you know? It's just one of these though eh? So I think I was just I was that…and then I had to do it [agreement from group] because my gran couldn't do it and my sister windnae – she wasn;t a nice sister so it wasn't like you could go to her and my dad he was just lying drunk so you couldnae tell him nothing, so I always just had to basically get on with it myself so it's just something that I've just always had, whereas some of my friends will even still…like I'll just go into Spar and you'll see people that are serving you in the Spar or the chemist and there's a man behind you and they're putting them in the bag dead quick. But sometimes I'll say "no, I'm no needing a bag cos it's bad for the environment" so I'm a bit on the environment eh? And see some people looking at you as if to say "you're walking about the shop with

them" and I'm like it's only towels, do you know what I mean? [agreement from group] it's nothing but…maybe its because its been such a big thing on me its just…

MM I still get a bit…

NB Yeah?

MM …kind of funny. I remember as a teenager, I was hovering around and if there was somebody I knew, I'd hang about in the shop until they'd go out [agreement from group] before I'd pick them up, you know I was really…

NB yeah my friends were like that…

MM … I used to get really embarrassed

NB …and I'd say to them " och, do you need that? Och I'll go for you ok?"

FACILITATOR why do you think people are so embarrassed…still?

MM I think its just cos it's a personal thing isn't it? And you know where you're going to put them and it's kind of…you know…?{agreement]

NB see there is an awfy stigma about it and that annoys me because it's the most natural thing in the world. If is wisnae for that, well I'd have loads of bairns and…[laughter]…I've got enough with the 3 I've got… but you know what I mean eh? And so I'll say that to my boys…there nae problem with it. Then as I say my boys can speak about is an even if any of my… well [names son] pals or that are in, I'm like "I'm PMTing [names son] gonna get me a bar of chocolate son" and he'll say "my mums PMTing" and you'll see some of them just looking but it's just an open thing in our house so…but you see sort of [names son] friends cringing then after it I think maybe too much information…[giggling from group] but maybe cos I'm just used to it with my boys or…do you know, its just… Sorry I'm speaking, nobody else can speak [no's from the rest of the group]…sorry

CE I think that em…I'm from [names place of birth] and we are...well we were a fairly conservative society until up to I think my grandmother's generation…so I think things have only started to change with

my parents generation and yep…you will never hover in front of Tesco's at the pads or tampons…you will never, never, never hover, you will put in what you need and you will go. I mean that's just the way it's done

MM Gosh

FACILITATOR it's interesting you know that we still continue that. It seems to be that everybody is slightly uncomfortable and seems a bit strange that people in this day and age are still uncomfortable…but thinking about that it's quite nice that everybody is quite comfortable talking about this sitting like this. Does this feel comfortable to you or would there be a more comfortable setting? Somewhere you'd feel more comfortable talking about your menstrual cycle or personal things like that?

CE I think the small group helps. I think if it gets too big it will be uncomfortable.[agreement from group].

FACILITATOR I think so as well. I think this is just a nice sized group

MM and I think it helps to know people…

FACILITATOR Yeah…

MM … you know I know you and I know your face, you know I've seen you about like, you know but yeah…

SH yeah, hanging about the uni, yeah I know your face too [laughing]

NB yeah I just smile at abody, abody's like "do I ken you?" I'm like.. I just smile at anyway.

FACILITATOR is there anywhere you would feel uncomfortable talking about the menstrual cycle

SH actually I think the room size helps as well. If you were in one of the big lecture theatres or like a big room…

MM yeah that's what I was going to say…a little bit…

SH I don't know why that is…but yeah I wouldn't be talking as much as I am I'm telling you [yeahs from the group]

NB yeah I think it would be uncomfortable like you say in a normal classroom, co s I think that's more difficult to talk when you're worrying about who's looking at you from behind or who turns round. [some agreement from group]. But when you're in a situation like this…basically there's no place to hide kind of thing, so… it's just a case of…..

FACILITATOR one of the sessions when I was recruiting from a class, you know I'd asked the women in the class to say back so I could tell them a little bit about my research…and we were there for ages…ages..and everybody had a story to tell and it was great and I though this is fabulous and everybody has got something to day [yeahs from group] and I wish that at that time I'd been recording and they were all really comfortable and I think that generally and I think women that women with women are very comfortable and I think that's a good way to go. [agreement from group]. I mean like…what about one to one? If we were sitting having this conversation, do think that would feel any different? Do you think you would be less comfortable? Do you think…?

ALL Yeah…

MM Yeah, I would be

FACILITATOR yeah so obviously it's a case of bouncing off each other then?...

ALL Yeah

FACILITATOR like you can say that then I can say that then?

ALL Yeah

MM I think with a one to one it's more erm, I don't know its kind of…the words gone out of my head…but like the digging may be a bit too personal and you feel a bit more erm exposed [agreement from group]…its bizarre I don't know why erm

SH yeah it would feel a bit more of an interrogation…it's not anything on you now[laughter from group] but anyone on a one to one basis you'd sort of go hmm. Sure my hairdresser starts asking questions and I'm…

FACILITATOR I'm uncomfortable with hairdressers too…[agreement from group] when the hairdresser starts talking I start feeling bad

SH yeah, yeah, I don't know what that is, its just when you're sitting there…

FACILITATOR well you know when your sitting there and you look in the mirror you never look good…well that's one thing anyway

NB I try to avoid mirrors so when you're talking to the hairdresser, you've got to talk to her in the mirror and I think that's the uncomfy thing about it.

SH but yeah this kind of size this is nice I think

MM yeah

NB …and it maybe would encourage you to volunteer more information cos just like maybe you were to say oh well that's kind of happened to me but maybe you wouldn't sort of want to say, but och you ken me...i probably would [laughter from group] I wouldn't probably shut up cos I'd probably just volunteer athing cos I am quite gobby

FACILITATOR it's good to be like that [laughs]. What about…has anybody been asked to take part in any research about the menstrual cycle previously?

FACILITATOR I did something with you once

MM I …was going to take part in yours then didn't because of my erm like … birth control

FACILITATOR [laughs] it's contraception – not a dirty word [laughter from the group]

MM [laughs] no I just couldn't think any…so yeah

FACILITATOR to NB so you did take part?

NB Yeah

FACILITATOR so what was it that made you want to take part?

NB cos it's just something that really interests me and I thought it was brilliant cos…I ken I shouldnae say this to you given you're a research lecturer but you ken research is no really my thing [names

facilitator], whereas your research, that's something I can actually get. See like reaction times and that, that goes [gestures] right over the top of my head right? Whereas that to me is interesting and it's cos…well just cos its interesting that's all.

FACILITATOR to MM why were you going to take part? What was it that…

MM erm…just to take part in your study really

FACILITATOR you didn't feel pressured into doing it?

MM No, no not at all…it's just I saw your advert and I thought I'll take part in it and then at the time I didn't fit the criteria that you were looking for erm…but not because I was particularly interested in the subject

FACILITATOR That's ok. Your allowed to feel like that [laughs]

FACILITATOR to SH and CE so neither of you have ever been asked by anybody to take part in menstrual cycle research?

CE No

FACILITATOR well that's interesting so maybe that's just a lack of people carrying out research on the menstrual cycle…ok…so what made you decide to take part in this?

CE …I think I got the email and I thought well…we are only so many female postgrad students so you're going to need people to talk to you so

FACILITATOR …so maybe a kind of camaraderie thing then? So what about the topic? Was it the topic that drew you in or was it just…well it's actually quite nice just to sit down and get to know people a little bit?

CE I think that if I received an email from I don't know…the forensic people…I would have said no

FACILITATOR ok

CE I mean this is something I can actually relate to…

FACILITATOR uh huh

CE I mean I experience it on a monthly basis, so I can talk about it [agreement from the group]

FACILITATOR what about you [names participant]

SH yeah, I think about yeah, spot on with [names another respondent]and I think I probably took part more because it was you guys [laughs and indicates group], yeah cos if this was like the sports people or something like that… then no, not a chance in hell [laughter from group]…but sports related so I wouldn't have done it anyway. [Laughter from the group]… but yeah, no I think it was more of a camaraderie thing. I eh I don't think I would actually really would have thought about the topic as much…yeah, cos I'm not really bothered about talking about it in this situation but then like you say [gestures to group] that's not to say that in other situations I wouldn't be as keen… but yeah it was just like yourself [gestures to group] and yeah…there's only so many of us [postgraduates]. [Agreement from others]

FACILITATOR ok…so kind of getting on to my last few structured questions for now ok…although as I say we can go off at a tangent…but… I am currently running a study which asks participants to complete a menstrual chart for 3 full cycles and to use ovulation kits for 8 days in each of the cycles. Ok so this has been running for a little while…Now what I've found is that participants are really reluctant to take part first and foremost or again they sign up, they start the study and then they don't complete it. So what I'd really like to hear are your thoughts on why you think women are reluctant to take part and if there's something about that particular study that I've just described that's making people reluctant to take part?

MM Does it involve like diaries and things as well?

FACILITATOR there's a menstrual chart and what they have to do on the menstrual chart is write 1 – day one of the cycle…2, 3, 4, 5, 6…all the way up and when they get to day 12 in the cycle, they start using ovulation kits and use them for 8 days and then they mark on the chart if ovulation takes place and they do that for 3 full cycles. Now they can do it for 3 cycles that follow each other or they can do it…do a cycle then as a few folk have done, have a holiday or whatever and then come back and do it as well

MM ok…I think personally its just the remembering probably…every day erm, it's it's like taking a tablet you know [agreement]… you know you remember for the first wee while and then after that, you know you're into your normal routine and you think "oh, I've not done that" so it could be that maybe they've missed…they've missed two or three days or whatever or more…

SH yeah, yeah cos you know I've done one of those experiments where you have a watch on that beeps and you have to say how you're feeling at that time, you know…and that was *really* annoying after day 2 [general laughter]…so its sort of the kind of thing I'd probably…I wouldn't be tempted to…you know after a bit I'd be "ah feck it…" [Laughter from group]…yes, maybe it's just myself, like… patience for remembering things like that but yeah that would kind of yeah the length of time I probably wouldn't be too keen on.

CE can I just ask…what is the ovulation kit?

FACILITATOR it's just a little erm it's a dip stick, so you essentially pee in a cup and dip the stick into the pee and then what happens is…almost like a pregnancy kit.. you get 2 lines on it…one line tells you if you've ovulated and if it doesn't appear then you haven't …sort of thing… that's the idea…very simple and very straightforward… I should have brought one along to show you.

CE so they write it down and them…they just hand you the paper basically?

FACILITATOR yeah, that's it

CE I think maybe, remembering to do it could be the problem, yeah

NB I would say probably the same as well

FACILITATOR Can I just change it….? What about…what do you think about ovulation kits? Do you think there might be anything about asking people to use ovulation kits that might be problematic?

SH you don't want the kits back do you? [laughter]

FACILITATOR oh no [laughs] *no*

SH cos that would be problematic [more laughter] I'd be out there and then [laughing] yeah they…yeah it's quite a personal thing to sort of say…even if they you know you haven't to hand them back you it does feel kind of…I don't know what the word I'm looking for is …Intrusive… or something into your cycle. So I think to do it they have to, you know they have to …I might give it a go but as I said timing and stuff would be the main thing for me you but I think people will maybe find it a little bit intrusive

FACILITATOR what about the…ovulation kits? How would you feel if I asked you to use an ovulation kit?

MM Me personally

FACILITATOR Yes

MM yeah, yeah I wouldn't worry…but then I suppose if someone was…you know maybe kind of looking for ovulation all the time or something like that or they were maybe sort of erm stressed out about whether they were ovulating or something maybe that would be something that…you know maybe if it showed up that they weren't ovulating you know

SH yeah that's true…that would probably get you worried…

FACILITATOR I do explain to my participants that women often don't ovulate it's nothing to be concerned about…women at university for example…at exam time… can cause you to have months when you don't ovulate, so that would be something that I would explain. Can you thing of any problems that using ovulation kits might cause you personally...if I was to give you a big envelope away with you…

NB just…maybe if you were planning on…I don't know like having a family at some point and then you weren't ovulating and then that would give you the worry and then…like as you say that you were to explain that…erm that you don't always…but it could still maybe make people frightened to basically learn the truth if they weren't or what ever

SH cos we have tv telling us that girls always have to have kids, you know and Ross was..erm Monica and Chandler and going daft and erm and you know you have it in your head you know that that means

there's something really dodgy going on here. So yeah…I think it's really drilled into you yeah…you know no ovulation then something's wrong yeah

NB yes cos when I'd says to you about like earlier about my doctor testing me thinking that…even though I didn't want more children…the thought of it was horrible

FACILITATOR Really? why do you think that was then?

NB I don't know…I think I just thought...well I'm quite useless now…yeah…cos maybe…as I say I don't want any more…like I've got one at almost 21 one at 16…my wee mistake[laughter]…[names son] at 8 cos I met a guy that told me he was infertile [gasps from others] member coming to… no actually that was when my son came and told me I was going to be a granny actually…so I've got a grandson at 2½ as well so I know that I would never ever have any more kids, but the thought that …I couldn't produce that quite frightened me. So even though I was thinking well maybe no more periods, and no more of this hassle…but...but then I still thought…it was still scary at the same time.

FACILITATOR Does anybody else feel like that?

MM erm up to a point...i wouldn't think I would be down about it if I was to say I couldn't have any more kids...i mean I don't want any more. But it's that kind of …I suppose that if that happened suddenly then you know you might think whoa well maybe I don't want one but…yeah

NB cos I think it's …that would be the knowing that…I mean I know that I don't want any more children but that's like my body telling me that's it right you're not having any more children so it's not like me

FACILITATOR you'd like to still have the choice?

NB yeah I think that's when I'd start to panic…

MM I think its my choice of contraception just now that's the...it's kind of semi-permanent so it's you know it probably wouldn't bother me much

FACILITATOR so here's something I'm always curious about…if you had the chance right, to keep your fertility…so continue to ovulate but not have periods would you do that?

SH Hell yeah

MM that's … that's my choice just now [laughter from group]

FACILITATOR has anyone heard of Seasonale© ?[no from group] it's a contraceptive pill where you only have 4 periods a year

NB but then do you still get the symptoms though?

FACILITATOR well you only have 4 periods a year so only 4 run ups

NB kenning my luck though my run up would last 3 months [laughter from the group]

NM it's really popular in America just now and it is kind of starting to appear here so for you [names one of group] it might be something you might want to discuss with your doctor I suppose. So if you could do that…if you could use a contraceptive, that meant you were completely in control, that it wouldn't affect your fertility in any way and you only had a period once every 4 erm 3 months

NB yeah I would jump at that yeah I think so

FACILITATOR so it's the period part…for you it's more the

NB yeah it's the symptoms

FACILITATOR … it's the lead up to it

NB yeah it's like…as soon as I get the period it's just …it's like that relief but then it starts and my symptoms will come around again and it's like "oh no…here we go again…" and it could be stupid things like erm…forgetfulness or like clumsiness…and one day cos always… remember [names a former male student] in our class…and I used to…and its like I turn in to a chewnie swinger and I'm like [adopts local dialect] "eh I ken"…and I swear a lot and [names male student] used to say…and I used to say to him [name] I'm sorry and he'd say "[name]I know cos your swearing…and he was the only guy in our group so he…even he knew when I was PMTing…just… and then like night sweats and like you get a funny

sick feeling you know I get a funny sore head and this can just like go on and on and then I get that mad rage and I'm like…you know you can stub your toe and cry and I'm like "right that it" you know its coming…or I get…even like…even like coming up say like a coursework or something like that and if I'm that stressed out and I've got my period I can just say nuht and that's it or its coming and I just cannae deal with that sort of thing…and that frightens me because I get my sort…my head on and I'm just no…and the after it I'm just like "oh how did I no put that in?" you know so…it worries me you know I'm like a split personality when I'm like that

FACILITATOR there's a lot of people feel like that [laughter]. Right, finally then… any suggestions as to how I might be able to encourage women to take part in research into the menstrual cycle?

[long period of silence 5 seconds]

CE take them to together in small groups?

NB maybe just saying to people you would only have a small amount…you would only be in with a small amount of people that'll maybe take the pressure off or whatever…see I dinnae ken cos I would just agree to it so its…

MM it would depend on what you were looking at…I think ovulation …cos you're looking at specific ovulation times…you know like times of your…

FACILITATOR it depends which of my studies your looking at

MM a yeah right

FACILITATOR cos what I'm trying to do is…the long term one where I'm asking them to fill them out…then ovulation strips for 8 days of their cycle then is cos I'm trying to map the cycle because a lot of the research that's done just now standardises cycles, so they treat everybody as if they have a 28 day cycle and if I go round the room, how many of you have got a 28 day cycle?

NB nah I dinnae [others shaking head in negative]

FACILITATOR you know it's actually quite rare to find, generally women who use contraceptives have a 28 day cycle…most women don't. so a lot of the research that's been done is focussed on that so they are testing at certain times based on a standardised cycle and I don't think that's telling you enough you know to talk about women in general. I think that only tells you about a standard 28 day cycle

MM yeah…I mean I think the main issue with that…that apart from your study is just people forgetting and just the fact that you know…that folk are busy

FACILITATOR Yeah?

MM I mean it's not…I don't think its erm…well…I mean personally, but I don't think it's anything to do with it being personal or invasive or anything like that…it's just the day to day kind of remembering

FACILITATOR mmhuh

MM folk forgetting to do it and erm

NB but then it's if you're going to an experiment looking at lets say reaction time…

FACILITATOR mmhuh

NB or whatever…you know you're in there for 10 minutes, you're done and you're out

FACILITATOR I've got another one like that as well

NB Yeah

FACILITATOR it takes a maximum of 15 minutes generally about 10 minutes and it is like testing things like that and still *really struggling* to get people to take part. And it doesn't matter if you take or don't take contraceptives for this one but…

MM but people don't want to do it?

FACILITATOR Yeah

NB maybe some people are just no interested…just as interested in it say just say like what you are or if maybe if it…if it doesn't affect people…cos I've got people that'll say to me "no I don't even believe

in PMT…no I don't get anything like that"…but now I'm like…well my pal [names friend], she's like that now "I remember when you used to go on about PMT to me and I never had it" and yet she gets it really bad now whereas she never used to get it when she was younger…erm so no it affects her, so I think…in some people could just like breeze through it [murmurs of agreement] and not really get a lot of things. So they maybe dinnae see… I dinnae mean this cheeky, but they maybe dinnae see the point in it as such

FACILITATOR indeed. So what about an incentive? What would encourage you to take part? Do you think incentives are the way to go? Is there something that…

SH yeah, yeah, lets be honest, yeah exactly erm, just during my Masters erm they had a form where they put up experiments that were going on in the university that they were looking for participants for…and they were for cash and they never had an issue finding anyone like erm it was more of an issue of can you get in there fast enough to do…

FACILITATOR to get the money…

SH yeah…that was a major incentive...you know even if it was like £4, people were flying for it

FACILITATOR Yeah

SH so there… I dare say it was the student thing, but there was cash involved and everyone wants it

FACILITATOR anything else?

NB I wouldn't need an incentive, cos I'm interested in it so sorry I cannae think of any…

MM I think possibly its…something that could be an issue for you is erm maybe some women just don't want to have to think about it…you know it's just like you know, it's just something that…they deal with it they actually…they don't want to stop and think about it…

FACILITATOR Mmhuh

MM you know maybe they're...you know it's another hassle you know [agreement from others] to deal with

FACILITATOR I think as well that a lot of the research deals with it negatively you know? [Agreement from group]…and I don't think that helps

MM well that's another thing if people aren't having an issue then…it…you know they perceive then that you're looking for something negative…erm…and maybe they don't want to know their …cognitions you know affected by their cycle or whatever…I don't know if that's what you're looking at but. I don't…I mean I think a lot of its just people have no time [agreement]…and it's just that kind of issue you know…its just the commitment [agreement] you know not wanting to have to commit to do like a certain period of time.

NB yeah…maybe if you're gonna just looking at like reactions or something it's just people, in and out and ain and out and it's maybe easier. But I'll no even reverse park when I'm… at certain times [laughter from group]…I just totally avoid it seriously, but it's just cos I think that I cannae dae that and yet I dae it every single day but…but sometimes I just think that nup I'm just no gonnae get in there. I get in that space every day but…ken so its… just mad

MM so no I can't answer you what would be…

FACILITATOR incentive…

MM …attractive

FACILITATOR cash…cold hard cash seems to be the way

SH yeah, its just that it worked during the Masters yeah

MM yeah…some of the students would erm erm, down at Bangor were earning quite a bit of money [agreement from others] doing the erm…the research studies

SH like 70 quid a week like…

MM yeah

SH yeah like this was a way of supplementing your earnings kind of thing

MM that's the downside of Abertay cos there's no money [laughter]

FACILITATOR Well ladies, thank you very much for taking part in that today [lots of laughter] it was really nice and I got some really interesting things out of there and I'll now go back and I'll transcribe it all and I'll have a look back and see what I can say about it all and I'll let you know what I'm going to do with it. I'm going to qualitatively analyse all of the data that I get. This is just the first focus group and I've got another one running on Thursday and hopefully I'm going to have another couple of them next week so I'm probably going to run about 6 or so and I'll get back to you all and let you know what I've found. But that was really useful. [All offering to take part in research studies]

Appendix 3.0

3.1 Participant Information Sheet.

Title of Project: Pinpointing ovulation

Invitation to take part:

My name is Noelle McAra and I am currently studying for a PhD at Abertay University. As part of my research I am carrying out the above study, which you are being asked to take part in.

Purpose of the study:

The aim of this study is to pinpoint exactly where in a natural menstrual cycle ovulation takes place. Much of the current research is based on ovulation occurring on day 14 of an "average" menstrual cycle, yet my earlier research has found that very few of those tested actually ovulated at that time.

What will I be asked to do?

You will be asked to complete a menstrual cycle chart for 3 complete menstrual cycles. This requires you to note the day of your cycle on the chart simply by writing 1, 2, 3 etc. You will also be asked to use ovulation kits for 8 days on each of the 3 cycles. So from day 12 of your cycle up to and including day 20 of your cycle you will use the ovulation kit and note on your chart if ovulation takes place. All ovulation kits will be supplied by the experimenter

Time Commitment:

Completing the menstrual chart each day will take a couple of seconds, and using the ovulation kits will take a couple of minutes each time a kit is used. Over the 3 cycles the total time commitment will be approximately 45 minutes.

Must I take part?

No, participation is entirely voluntary. You may decide to stop being a part of the research study at any time without explanation.

Are there any risks?

There are no known risks for you in this experiment.

Confidentiality/Anonymity:

The data collected will not contain any personal information about you other than your age, and how many children you have had. No information that is likely to identify you will be published.

Further Information about this project:

If you require further information about this study you can contact the researcher (Noelle McAra n.mcara@abertay.ac.uk) or her supervisor (Dr Lynn Wright l.wright@abertay.ac.uk tel: 01382308332).

THE SCHOOL OF SOCIAL AND HEALTH SCIENCES RESEARCH ETHICS COMMITTEE HAS REVIEWED AND APPROVED THIS RESEARCH STUDY.

3.2 Menstrual Chart

April	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of Cycle																															
May	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of Cycle																															
June	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of Cycle																															
July	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of Cycle																															

April	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of Cycle																															
May	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of Cycle																															
June	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of Cycle																															
July	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Day of Cycle																															

Participant number

When should you test?

Do not use first morning urine for testing. The best time to use is between 10 am and 8 pm. Try to collect the urine at around about the same time each day. You can refrigerate the sample for testing later in the day, but make sure that it comes up to room temperature first.

Reading the result

POSITIVE RESULT

The test line will be of equal or greater density than the control line which is the upper line.

e.g. Control line OR Control line

Test line Test line

NEGATIVE RESULT

The test line will less intense than the control line or will not be visible

e.g. Control line OR Control line

Test line Test line absent

3.4 Demographic Questionnaire

Participant Number _____

Age	_____
Do you know the length of your menstrual cycle? (Please Circle)	Yes No
If yes, how long is your menstrual cycle? (an average cycle is 28 days)	_____ days
How regular is your menstrual cycle (Please Circle)	1. Regular 2. Fairly regular 3. Irregular
Do you use hormonal contraceptives	Yes No
If yes which type? (Please Circle)	1. Contraceptive Pill 2. Contraceptive Patch 3. Contraceptive Injection 4. Contraceptive Implant

3.5 Participant Information Sheet.

Title of Project: Pinpointing ovulation

Invitation to take part:

My name is Noelle McAra and I am currently studying for a PhD at Abertay University. As part of my research I am carrying out the above study, which you are being asked to take part in.

Purpose of the study:

The aim of this study is to pinpoint where in a natural menstrual cycle ovulation takes place. Much of the current research is based on ovulation occurring on day 14 of an "average" menstrual cycle, yet my earlier research has found that very few of those tested actually ovulated at that time.

What will I be asked to do?

You will be asked to complete a menstrual cycle chart for 3 complete menstrual cycles. This requires you to note the day of your cycle on the chart simply by writing 1, 2, 3 etc. You will also be asked to use ovulation kits for 8 days on each of the 3 cycles. So from day 12 of your cycle use an ovulation kit each day for 8 days and note on your chart if ovulation takes place. All ovulation kits will be supplied by the experimenter

Time Commitment:

Completing the menstrual chart each day will take a couple of seconds, and using the ovulation kits will take a couple of minutes each time a kit is used. Over the 3 cycles the total time commitment will be approximately 45 minutes.

Must I take part?

No, participation is entirely voluntary. You may decide to stop being a part of the research study at any time without explanation.

Are there any risks? There are no known risks for you in this experiment.

Confidentiality/Anonymity:

The data collected will not contain any personal information about you other than your age, and how many children you have had. No information that is likely to identify you will be published.

Further Information about this project:

If you require further information about this study you can contact the researcher (Noelle McAra n.mcara@abertay.ac.uk) or her supervisor (Dr Lynn Wright l.wright@abertay.ac.uk Tel: 01382 308332).

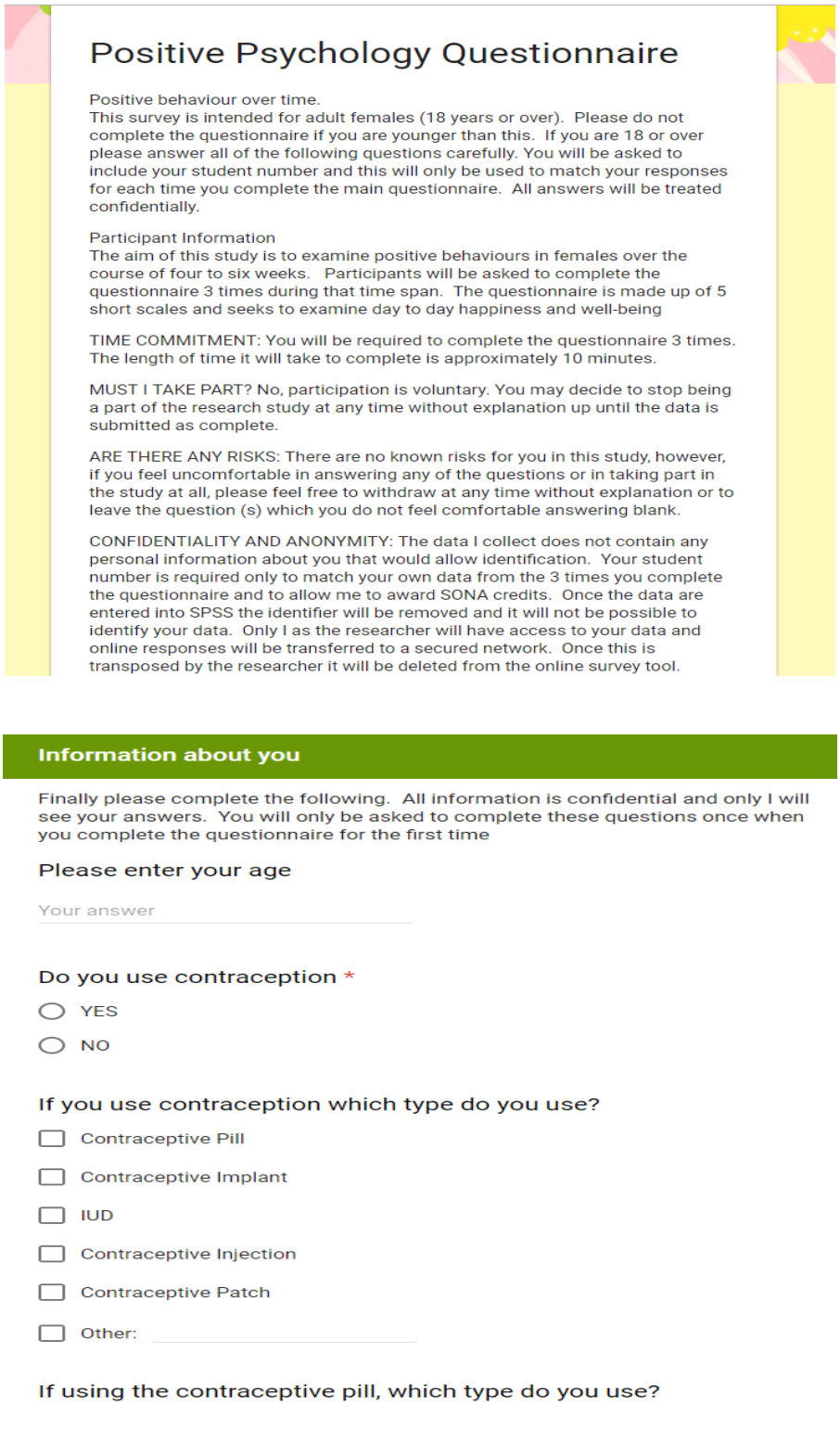
By signing below you are indicating that you have read and understood the Participant Information Sheet and that you are willing to participate in this research study. If you decide at any time to withdraw from the study please return the materials using the SAE provided.

Name_____**Email**_____

THE SCHOOL OF SOCIAL AND HEALTH SCIENCES RESEARCH ETHICS COMMITTEE HAS REVIEWED AND APPROVED THIS RESEARCH STUDY.

Appendix 4.0

4.1 Screenshots of online version of questionnaire from Google Forms



Positive Psychology Questionnaire

Positive behaviour over time.
This survey is intended for adult females (18 years or over). Please do not complete the questionnaire if you are younger than this. If you are 18 or over please answer all of the following questions carefully. You will be asked to include your student number and this will only be used to match your responses for each time you complete the main questionnaire. All answers will be treated confidentially.

Participant Information
The aim of this study is to examine positive behaviours in females over the course of four to six weeks. Participants will be asked to complete the questionnaire 3 times during that time span. The questionnaire is made up of 5 short scales and seeks to examine day to day happiness and well-being

TIME COMMITMENT: You will be required to complete the questionnaire 3 times. The length of time it will take to complete is approximately 10 minutes.

MUST I TAKE PART? No, participation is voluntary. You may decide to stop being a part of the research study at any time without explanation up until the data is submitted as complete.

ARE THERE ANY RISKS: There are no known risks for you in this study, however, if you feel uncomfortable in answering any of the questions or in taking part in the study at all, please feel free to withdraw at any time without explanation or to leave the question (s) which you do not feel comfortable answering blank.

CONFIDENTIALITY AND ANONYMITY: The data I collect does not contain any personal information about you that would allow identification. Your student number is required only to match your own data from the 3 times you complete the questionnaire and to allow me to award SONA credits. Once the data are entered into SPSS the identifier will be removed and it will not be possible to identify your data. Only I as the researcher will have access to your data and online responses will be transferred to a secured network. Once this is transposed by the researcher it will be deleted from the online survey tool.

Information about you

Finally please complete the following. All information is confidential and only I will see your answers. You will only be asked to complete these questions once when you complete the questionnaire for the first time

Please enter your age

Your answer

Do you use contraception *

- ○ YES
- ○ NO

If you use contraception which type do you use?

- ☐ Contraceptive Pill
- ☐ Contraceptive Implant
- ☐ IUD
- ☐ Contraceptive Injection
- ☐ Contraceptive Patch
- ☐ Other:

If using the contraceptive pill, which type do you use?

4.2 State Trait Cheerfulness Inventory (STCI-S) ***(Ruch, Kohler, & van Thriel, 1997).***

S T C I - S <18>

Name (Code): _____ Age: |__|__| Gender: male O female O

Instructions:

The following statements refer to your current mood and mental state. Please try as much as possible to describe your current feelings and state of mind by marking an X through one of the four alternatives. Please use the following scale:

(1) strongly disagree

(2) moderately disagree

(3) moderately agree

(4) strongly agree

For example:

I have an even temper. ..... (1) (2) (3) (4)

If you strongly agree with this statement, that is, if you have an even temper at this moment, mark an X through (4). If you strongly disagree, that is, if you at present do not have an even temper at all, mark an X through (1).

If you have difficulty answering a question, pick the solution that most applies.

Please answer every question, do not omit any.

1. I feel gloomy. ..... (1) (2) (3) (4)
2. I am set for serious things. ..... (1) (2) (3) (4)
3. I am cheerful. ..... (1) (2) (3) (4)
4. I have important things on my mind. ..... (1) (2) (3) (4)
5. I am in a crabby mood. ..... (1) (2) (3) (4)
6. I am sad. ..... (1) (2) (3) (4)
7. I am ready to have some fun. ..... (1) (2) (3) (4)
8. I have a serious mental attitude. ..... (1) (2) (3) (4)
9. I could laugh at the drop of a hat. ..... (1) (2) (3) (4)
10. I am peeved. ..... (1) (2) (3) (4)
11. I'm walking on air. ..... (1) (2) (3) (4)
12. I regard my situation objectively and soberly. ..... (1) (2) (3) (4)
13. I am amused. ..... (1) (2) (3) (4)
14. I am in a serious frame of mind. ..... (1) (2) (3) (4)
15. I am in a thoughtful mood. ..... (1) (2) (3) (4)
16. I feel dejected. ..... (1) (2) (3) (4)
17. I am delighted. ..... (1) (2) (3) (4)
18. I feel grouchy. ..... (1) (2) (3) (4)

4.3 Subjective Happiness Scale ***(Lyubomirsky & Lepper, 1999)***

Subjective Happiness Scale (SHS)

By Sonja Lyubomirsky, Ph.D.

For each of the following statements and/or questions, please circle the point on the scale that you feel is most appropriate in describing you.

1. In general, I consider myself:

1	2	3	4	5	6	7
not a very happy person						a very happy person

2. Compared to most of my peers, I consider myself:

1	2	3	4	5	6	7
less happy						more happy

3. Some people are generally very happy. They enjoy life regardless of what is going on, getting the most out of everything. To what extent does this characterization describe you?

1	2	3	4	5	6	7
not at all						a great deal

4. Some people are generally not very happy. Although they are not depressed, they never seem as happy as they might be. To what extent does this characterization describe you?

1	2	3	4	5	6	7
not at all						a great deal

4.4 Mindful Attention Awareness Scale (MAAS) ***(Brown & Ryan 2003)***

Day-to-Day Experiences

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what *really reflects* your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5	6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6
I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5	6
I rush through activities without being really attentive to them.	1	2	3	4	5	6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
I find myself listening to someone with one ear, doing something else at the same time.	1	2	3	4	5	6
I drive places on 'automatic pilot' and then wonder why I went there.	1	2	3	4	5	6
I find myself preoccupied with the future or the past.	1	2	3	4	5	6
I find myself doing things without paying attention.	1	2	3	4	5	6
I snack without being aware that I'm eating.	1	2	3	4	5	6

4.5 Curiosity and Exploration Inventory (CEI-II) ***(Kashdan, et al., 2009)***

Curiosity and Exploration Inventory (CEI-II) *Instructions*: Rate the statements below for how accurately they reflect the way you generally feel and behave. Do not rate what you think you should do, or wish you do, or things you no longer do. Please be as honest as possible.		Very Slightly or Not At All	A Little	Moderately	Quite a Bit	Extremely
1.	I actively seek as much information as I can in new situations.	1	2	3	4	5
2.	I am the type of person who really enjoys the uncertainty of everyday life.	1	2	3	4	5
3.	I am at my best when doing something that is complex or challenging.	1	2	3	4	5
4.	Everywhere I go, I am out looking for new things or experiences.	1	2	3	4	5
5.	I view challenging situations as an opportunity to grow and learn.	1	2	3	4	5
6.	I like to do things that are a little frightening.	1	2	3	4	5
7.	I am always looking for experiences that challenge how I think about myself and the world.	1	2	3	4	5
8.	I prefer jobs that are excitingly unpredictable.	1	2	3	4	5
9.	I frequently seek out opportunities to challenge myself and grow as a person.	1	2	3	4	5
10.	I am the kind of person who embraces unfamiliar people, events, and places.	1	2	3	4	5

Stretching: 1,3,5,7 / Embracing: 2,4,6,8.10.

4.6 The Trait Hope Scale ***(Snyder et al., 1991)***

The Trait Hope Scale

Directions: Read each item carefully. Using the scale shown below, please select the number that best describesYOU and put that number in the blank provided.

1. = Definitely False
2. = Mostly False
3. = Somewhat False
4. = Slightly False
5. = Slightly True
6. = Somewhat True
7. = Mostly True
8. = Definitely True

___ 1. I can think of many ways to get out of a jam.

___ 2. I energetically pursue my goals.

___ 3. I feel tired most of the time.

___ 4. There are lots of ways around any problem.

___ 5. I am easily downed in an argument.

___ 6. I can think of many ways to get the things in life that are important to me.

___ 7. I worry about my health.

___ 8. Even when others get discouraged, I know I can find a way to solve the problem.

___ 9. My past experiences have prepared me well for my future.

___10. I've been pretty successful in life.

___11. I usually find myself worrying about something.

___12. I meet the goals that I set for myself.

Note. When administering the scale, it is called The Future Scale. The agency subscale score is derived by summing items 2, 9, 10, and 12; the pathway subscale score is derived by adding items 1, 4, 6, and 8. The total Hope Scale score is derived by summing the four agency and the four pathway items.

4.7 Checking of order effects.

There was a concern that some session effects might be observed in this study. To check this all scores were analysed by test session rather than by menstrual cycle phase. Participants took part in three sessions and these were simply recorded as session one two and three and menstrual cycle phase for each test session was recorded. To ensure no order effects occurred responses on all scales were compared by session regardless of menstrual cycle phase.

Table 2

Mean questionnaire scores for all questionnaire scales

see	Individual Scales	Session 1	Session 2	Session 3
STCI	Cheerfulness	15.1 (4.2)	16.6 (4.2)	16.2 (3.4)
	Seriousness	16.7 (3.7)	16.7 (2.8)	18 (3.1)
	Bad Mood	10.2 (3.9)	9.6 (4.2)	9.6 (4)
SHS		1.6 (3.2)	1.6 (3.2)	1.6 (3.2)

As Table 2 shows participant scores were similar across the three test sessions for all measures. Scores on all measures were similar between the first and second test session, between the second and third test session and between the first and third test session

1 x 3 within subjects ANOVA was carried out on STCI measures and revealed no significant effect of test session on cheerfulness scores ($p = .77$) nor on seriousness scores ($p = .55$) nor on bad mood scores ($p = .31$).

1 x 3 within subjects ANOVA was carried on SHS scores and revealed no significant effect of test session on subjective happiness scores ($p = .76$)